Rapid decreases in relative testes mass among monogamous birds but not in other vertebrates

Authors and Affiliations

Joanna Baker[1], Stuart Humphries[2], Henry Ferguson-Gow[3], Andrew Meade[1] and Chris Venditti[1]

[1]School of Biological Sciences, University of Reading, Reading, RG6 6BX (UK), [2]School of Life Sciences, University of Lincoln, Joseph Banks Laboratories, Green Lane, Lincoln LN6 7DL (UK), [3]Centre for Biodiversity and Environment Research, Department of Genetics, Evolution and 8 Environment, University College London, Gower Street, London, WC1E 6BT (UK)

Short title

Rapid evolution of vertebrate testes mass

Keywords

Relative testes mass, vertebrates, polyandry, monandry, sperm competition, evolutionary rates, adaptation

Article Type

Letter

Article details

Abstract (149 words), Main text (4887 words), 78 references, 4 Figures, no tables or text boxes.

Corresponding author

Chris Venditti, Lyle Building, University of Reading School of Biological Sciences, University of Reading, Reading, RG6 6BX (UK). Phone: +44 (0)118 378 4683. Email: c.d.venditti@reading.ac.uk.

Statement of authorship

All authors contributed to this work, including the writing of the manuscript.

Data accessibility statement

This manuscript generates no new data, using previously published measurements and are all are provided as an appendix to the article.

Abstract

Larger testes produce more sperm and therefore improve reproductive success in the face of sperm competition. Adaptation to social mating systems with relatively high and low sperm competition are therefore likely to have driven changes in relative testes size in opposing directions. Here, we combine the largest vertebrate testes mass dataset ever collected with phylogenetic approaches for measuring rates of morphological evolution to provide the first quantitative evidence for how relative testes mass has changed over time. We detect explosive radiations of testes mass diversity distributed throughout the vertebrate tree of life: bursts of rapid change have been frequent during vertebrate evolutionary history. In socially monogamous birds, there have been repeated rapid reductions in relative testes mass. We see no such pattern in other monogamous vertebrates; the prevalence of monogamy in birds may have increased opportunities for investment in alternative behaviours and physiologies allowing reduced investment in expensive testes.

Background

Testes mass is extremely variable across vertebrates, even after considering its association with body mass (e.g. MacLeod & MacLeod 2009, this variation is visualized in Figure 1). Many decades of research have shown that one of the most important factors explaining variation in relative testes size (including mass) among species is sperm competition. Sperm competition arises when sperm from multiple males compete for the fertilization of a single female (Parker 1970). Increasing testes size is one way of improving male reproductive success in the presence of high levels of sperm competition (Parker *et al.* 1997; Parker & Pizzari 2010; Vahed & Parker 2012). Larger testes are likely to produce more sperm (Møller 1988, 1989; Stockley *et al.* 1997) which is a key determinant of competitive fertilization success (Parker & Pizzari 2010). Accordingly, sperm competition has repeatedly been demonstrated to be linked to differences in testes sizes both within individual species (Hosken & Ward 2001; Schulte-Hostedde & Millar 2004; Simmons & García-González 2008) and amongst whole taxonomic groups including (but not limited to) butterflies (Gage 1994), bats (Hosken 1998) and frogs (Byrne *et al.* 2002) – reviewed in Parker *et al.* (1997) .

The level of sperm competition a species faces can be approximated using social mating system (e.g. Harcourt *et al.* 1981; Pitcher *et al.* 2005). Socially polyandrous species – where females form social bonds with two or more males within a single breeding season – have ample opportunity to mate with multiple males and thus have relatively high levels of sperm competition (Smith 1984). In comparison, socially monogamous species form pair-bonds between a single male and a single female that persist throughout an entire breeding season. Although extra-pair copulations occur within socially monogamous species (e.g. DeWoody & Avise 2001; Griffith *et al.* 2002), compared with socially polyandrous species they have less opportunity for mating with multiple males and therefore lower levels of sperm competition. The amount of sperm competition faced by socially polygynous species, where a single male forms social bonds with multiple females within a single breeding season, may be different from both socially polyandrous and monogamous species (e.g. Hasselquist & Sherman 2001; Soulsbury 2010). There are two opposing predictions made for the level of sperm competition faced by socially polygynous species. Firstly, where males invest in increasing the number of socially-bonded females, they are unlikely to be able to mate-guard as effectively, potentially leading to increases in the level of sperm competition compared with social monogamy (Birkhead & Møller 1992). Secondly, female choice may lead to a reduced investment of females seeking or accepting extra-pair copulations (Møller 1992; Hasselquist & Sherman 2001). This reduction in female investment in extra-pair mating coupled with a reduced ability of male investment in extra-pair mating owing to defense of his territory may actually decrease the amount of sperm competition faced by polygynous species (Hasselquist & Sherman 2001).

Here, in line with the expectations outlined above, we consider the following social mating systems separately: monogamy, polygyny, and social polyandry (including polygynandry, where multiple females and males form social bonds within a breeding season). In general, the testes of males belonging to social mating systems comprising multiple males are likely to be larger than those comprising only a single male. Such an expectation has been upheld in many groups spanning the vertebrate tree of life (e.g. Harcourt *et al.* 1981; Jennions & Passmore 1993; Parker *et al.* 1997; Pitcher *et al.* 2005), though reportedly not in all cases (e.g. Iossa *et al.* 2008).

We seek to provide the first comprehensive phylogenetic analysis of how testes mass diversity has evolved in combination with social mating system across vertebrates. We now have the opportunity to use phylogenetic approaches that simultaneously characterize the underlying testes-body mass relationship whilst detecting rapid bursts in the rate of relative testes mass evolution (Venditti *et al.* 2011; Baker *et al.* 2016). Where the rate of evolution is faster, testes mass changes more than expected along an individual branch given the background rate of evolutionary change acting across all vertebrates and the amount of time that it has had to evolve (see Methods). Testes are energetically expensive to develop and maintain (e.g. Meerlo *et al.* 1997; Schulte-Hostedde *et al.* 2005; Hayward & Gillooly 2011). Therefore, any rapid changes in testes mass along the branches of the vertebrate phylogenetic tree are likely to be a consequence of natural selection (most likely sexual selection imposed by sperm competition), reflecting periods of intense adaptive change (Baker *et al.* 2016; Baker & Venditti 2019).

We expect sperm competition to be a key driver of such intense adaptation in testes mass, and possibly may have even driven long term directional change in relative testes mass over millions of years. Directional trends in relative testes mass could occur in either direction. For example, social polyandry may have maintained high levels of sperm competition and thus exerted pressure for adaptive (i.e. rapid) increases in relative testes mass. On the other hand, in social mating systems with relatively lower levels of sperm competition it may have been beneficial to minimize investment in expensive reproductive tissues in favour of other expensive tissues such as brains (Aiello & Wheeler 1995; Pitnick *et al.* 2006) or alternative adaptations for improving reproductive success such as weapons, displays, or paternal care (e.g. Møller 2000; Lüpold *et al.* 2014; Buzatto *et al.* 2015; Dunn *et al.* 2015). In such cases, we might expect to see rapid relative testes mass reductions. Such bursts of directional rapid evolutionary change – in either direction – if repeated over millions of years along many branches of the vertebrate tree of life, could combine to give rise to sustained directional changes in relative testes mass over the last 400 million years of vertebrate evolutionary history (Baker *et al.* 2015). Thus, we might expect to see a trend towards larger relative testes mass in socially polyandrous species, and smaller relative testes mass in socially monogamous and polygynous species – with potential differences between the two.

Material and Methods

Data and Phylogenetic tree

We collected testes mass (grams, g) and body mass (g) from the literature for 1913 vertebrate species matched to the time tree of life (Hedges *et al.* 2015). Sample sizes for each group are shown in Figure 2. We included only a single source per species in order to avoid conflicts among datasets; more detail on our data collection procedure can be found in the supplementary text. We $\log_{10}$-transformed all testes masses and body masses (Figure 1).

We collected information on the social mating system from the literature, assigning a total of 1445 of the species for which we had testes mass to one of three possible states (monogamy, polygyny, polyandry/polygynandry). For birds, we excluded species where the social mating system is to be considered "cooperative" as in many cases, group composition in terms of numbers of males and females was unspecified. For frogs, only coarse data was available and so the mating system of these species was collected as a dichotomous variable: monogamous/polygynous and polyandrous/polygynandrous. More details on how species were classified can be found in the supplementary text. Our total sample sizes for species with social mating system data were as follows: 63 fish, 169 frogs, 845 birds, and 358 mammals.

Our full protocol, reference list, and dataset are available in the online supplementary material (see Appendix S1 and Table S1).

Rate heterogeneity

We detected variation in the rate of testes mass evolution after accounting for body mass using the *variable rates regression model* (Venditti *et al.* 2011; Baker *et al.* 2016). This Bayesian Markov chain

Monte Carlo regression technique acts within a phylogenetic generalized least squares (GLS) framework to estimate the rate of evolution in the phylogenetically structured residual error of a regression model along the branches of a tree (Baker *et al.* 2016). The model simultaneously estimates an underlying Brownian motion process (background rate, σ_b^2) along with a set of rate scalars *r* defining branchwise shifts (identifying branches evolving faster ($r > 1$) or slower ($0 \leq r < 1$) than the background rate). The model then multiplies the original branch lengths (measured in time) by the corresponding *r* for each branch, resulting in a scaled phylogeny where longer branches (compared to their original length in time, $r > 1$) indicate faster rates of morphological evolution, and shorter branches ($0 \leq r < 1$) have slower rates. These branch-specific scalars therefore optimize the fit of the phylogeny to the underlying background rate σ_b^2 given the inferred phenotypic change along each branch.

We used Bayes Factors (BF) to identify evidence for rate heterogeneity, calculated as $BF = -2\log_e[m_1/m_0]$, comparing the marginal likelihood of our variable rates model (m_1) to that of a model with a single underlying σ_b^2 (m_0). Marginal likelihoods were estimated using stepping-stone sampling (Xie *et al.* 2010) implemented in BayesTraits (Pagel *et al.* 2004). For each of 200 stones, we ran 1 million iterations drawing values from a beta-distribution (α = 0.40, β = 1) (Xie *et al.* 2010) and discarded the first 250,000 iterations as burn-in. The variable rates model is implemented within a Markov Chain Monte Carlo framework, giving us a posterior distribution of estimated *r* and σ_b^2. We visually checked all traces to ensure models were robust and had reached convergence. We ensured effective sample sizes of greater than 500 for all parameters, and results were replicated over multiple independent chains.

For each branch we calculate an *optimized rate* ($\sigma_v^2 = \sigma_b^2 r$). We then identified branches where σ_v^2 differs from the background rate (σ_b^2). For a given branch, where *r* > 1 in more than 50% of the posterior, we considered $\sigma_v^2 \neq \sigma_b^2$; this is where more than half of all iterations in the MCMC chain show an increase (or decrease where *r* < 1) in the rate of morphological evolution. All other branches were assumed to be evolving according to the background rate ($\sigma_v^2 = \sigma_b^2$). We then identified clades of 10 or more species across the vertebrate phylogeny that have inherited wholescale increases in the rate of relative testes mass evolution by comparing ancestor-descendant branch pairs. These clades are termed *heritable rate shifts* and are defined on the basis of two criteria: i) where a branch differs in rate (σ_v^2) from its ancestor in > 50% of the posterior distribution and ii) where all descendant branches inherit this new rate; i.e. all descendant branches do not differ in rate from the initial ancestral lineage. In this way, we define heritable rate shifts on the basis of an increase in variance throughout the entire clade – the clade has more variation about the regression line than would be expected given the underlying relationship between testes mass and body mass (Baker *et al.* 2016). Rate decreases are identified in the same way; in these cases, the clade would have a reduction in variation about the regression line. All branches where $\sigma_v^2 \neq \sigma_b^2$ are considered instances of rapid evolutionary change (or decelerated evolution, where $r < 1$).

Characterizing the testes-body mass relationship

We identified rate heterogeneity using a bivariate regression between testes mass and body mass across all vertebrates (N = 1913). Metabolic theory predicts a simple linear relationship between testes mass and body mass with scaling differences among groups (Hayward & Gillooly 2011) much like that observed for other organs (Peters 1986). We therefore additionally ran a model estimating an interaction between taxonomic group and body mass as a fixed effect, allowing a different slope within each major clade (fish, frogs, birds, mammals, and reptiles).

We calculate the proportion of the posterior distribution of each regression parameter that crosses zero (P_x). Where $P_x < 0.05$, this means that less than five percent of the posterior distribution overlaps with zero, and we consider a variable to be substantially different from zero. To compare between parameters we calculated the difference between each pair of parameters at each iteration and looked at the posterior distribution of differences. Where the proportion of this distribution crossing zero is less than 5% ($P_{x[diff]}$. < 0.05), we consider two parameters to be different from one another.

Directionality in testes mass evolution and the role of social mating system

Our method of detecting rate heterogeneity introduces meaningful variation into the branch lengths of a phylogeny, which makes it possible to study adaptive trends in trait evolution (Baker *et al.* 2015).

Longer branches represent an increase in the rate of evolution arising from selective influences (Baker *et al.* 2016; Baker & Venditti 2019); they have experienced more relative testes mass change than would be expected given their length in time. The sum of all rate-scaled branches along the evolutionary path of a species (*path-wise rates*) can therefore be used to measure the total amount of adaptive change that species has experienced during its history (Baker *et al.* 2015). We used this logic to determine whether there has been any long-term adaptive trends in vertebrate relative testes mass evolution and whether they differ among species experiencing different levels of sperm competition.

In order to estimate whether there has been any adaptive directionality in relative testes mass evolution, we incorporated social mating system, path-wise rate and an interaction between the two variables as additional explanatory factors into the testes-body mass regression model. We term these our *trends analyses*. We only do this where we have 10 data points per parameter (Freckleton & Watkinson 2001) i.e. N >= 20 (we estimate a slope and intercept for the relationship between testes mass and path-wise rate after accounting for shared ancestry and body mass). Sample sizes for individual mating systems are shown in Figure 4 and details are found in the supporting information. We have too few monogamous (N = 15) and polygynous fish (N = 8) to estimate two separate slopes, so for this group we combined monogamy and polygyny into a single category (as in frogs). Too few data were available for reptiles and so these taxa were excluded from these analyses.

We performed all trends analyses within a maximum-likelihood GLS framework (Pagel 1999). We used the median path-wise rate as our predictor variable (but results do not qualitatively differ using the mean or mode). We assessed significance of parameters using standard p-values and compare model fit using likelihood ratio (*D*) tests. All trends analyses were conducted on the median rate-scaled phylogeny in order to account for differences in the amount of testes mass change expected owing to rate heterogeneity (Baker *et al.* 2015) and were limited to the data to the species for which we could collect mating system data (see above and electronic supplementary material). To account for multiple hypothesis testing (multiple categories of mating system within each group), we adjust p-values using Bonferonni corrections.

Where the slope of the relationship between testes mass and median path-wise rate was determined to be non-significant, we ran an additional model that estimated the difference in the intercept of the testes-body mass regression relationship for the mating system of each group. This was to determine whether there were significant differences in the average relative testes mass of species belonging to each social mating system – after accounting for phylogenetic shared ancestry and the rate of testes mass evolution.

Code availability

All analyses in the present study were conducted using the freely available software BayesTraits v3.0, available at the following website:

http://www.evolution.rdg.ac.uk/BayesTraitsV3/BayesTraitsV3.html.

Results

We find that testes mass evolution across vertebrates is best described by a model that allows a different relationship with body mass (i.e. a different allometric slope) for each of the five major classes we include (mammals, birds, fish, reptiles, and amphibians). There are substantial differences in slope among groups (Figure 2), with very little overlap in estimated parameters. With the exception of reptiles, less than 5% of the proportion of the posterior distribution of differences between each pair of slope parameters $P_{[x]}$ crosses zero. The magnitude of the difference varies from group to group and can be observed in Figure 2. Our results conform to theory predicting a simple linear relationship between testes mass and body mass, with variation amongst major groups (Hayward & Gillooly 2011). Deviations away from the underlying relationships arise in the form of rate heterogeneity (Figure 3).

Our results indicate rapid evolutionary change in both directions throughout the vertebrate tree of life (Figure 3). We find 'very strong' support (Raftery 1996) for rate heterogeneity compared to a model estimating only a single rate of evolution (BF = 660.86, Methods). The rate heterogeneity we identify arises in the form of eleven independent heritable rate shifts (Figure 3, Table S2) wherein a monophyletic group of 10 or more species inherits a single accelerated rate, resulting in a radiation of relative testes mass diversity (Methods). The heritable rate shifts we identify are distributed across the vertebrate phylogeny, occurring within all major vertebrate groups except reptiles (Figure 3). We additionally observe rate increases in 22 smaller clades (N ranging between 2 and 9) as well as 11 individual species (Table S2) – these increases in rate might indicate incipient heritable shifts. We observe only a single mean shift, where a change in the intercept of the regression relationship between testes mass and body mass manifests as a rate increase along an internal branch (Baker *et al.* 2016). This is observed within mammals, and more specifically, within rodents – along the branch leading to Australian hopping mice (genus *Notomys,* Table S2). The branch leading to *Notomys cervinus*, the fawn hopping mouse, was identified as a rate decrease – this species has experienced less change in testes mass than expected for its body mass and its branch length in time.

We find a significant negative relationship between testes mass and mean path-wise rate for monogamous birds only ($p < 0.01$, Figure 4). There is no such significant relationship in birds belonging to any other social mating system. These results are supported using cross-validation tests (see supplementary text for details).

In no other social mating system for any other group do we find a significant relationship between path-wise rate and testes mass. However, it is significantly better to estimate separate intercepts allowing differences between the average testes mass of species belonging to different mating systems for each of these groups (frogs: $D = 16.094$, $p < 0.01$, df = 1; fish: $D = 6.07$, $p = 0.05$, df = 2; mammals: $D = 11.97$, $p = <0.01$, df = 2). In all three groups where we estimate mean differences between testes mass of species belonging to different social mating systems (fish, frogs, and mammals), we find that polygynandrous species have significantly larger testes than monogamous species (Figure 4). No other results are affected. In mammals, polygynandrous species also have larger testes than polygynous species (Figure 4). No other comparison is significant (Figure 4). Correcting for multiple hypothesis testing (Bonferroni correction) does not alter our results, with one exception: statistical support for the differences in testes sizes between mating systems for fish is only marginal, and is non-significant after correcting for multiple hypothesis testing.

Discussion

Our results highlight that social mating systems (and associated variation in sperm competition) are likely to have played a key role during the evolution of vertebrate testes. In line with expectations, we find that vertebrates with polyandrous mating systems tend to have significantly larger relative testes mass than monandrous vertebrates (Figure 4). Furthermore, several bursts of rapid testes mass change have punctuated vertebrate evolutionary history that are likely to have been linked to changes in reproductive biology. For example, we observe a heritable rate shift in the tree frog family Rhacophoridae (Roberts & Byrne 2011) (Figure 3E, Table S2) which has a high occurrence of polyandry (Roberts & Byrne 2011) and includes the grey foam nest tree frog (*Chiromantis xerampelina*), described as the most polyandrous of all vertebrate species (Byrne & Whiting 2011). We find rapid evolution leading to very tiny testes in a 'classic' example of a monogamous species (Ribble 1991), the California mouse *Peromyscus californicus* (nearly ten times the rate observed among other therian mammals, Table S2). The single mean shift we identify is a reduction in relative testes mass found within the monogamous hopping mouse genus *Notomys*, the remarkably small testes of which are thought to be linked with increased sperm efficiency (Breed & Jason 2000). A small group of pipefish – renowned for unusual reproductive biology (Kvarnemo & Simmons 2004) – have testes evolving at nearly twice the background rate (Figure 3, Table S2). Sex role reversal such as that observed among some pipefish (Berglund & Rosenqvist 2003) can lead to low levels of sperm competition even in species with high levels of polyandry (Rose *et al.* 2013) which might explain some of the rapid testes mass changes observed in this group. Although sex role-reversal could lead to some of the other rapid evolutionary changes in relative testes masses that we observe, this phenomenon is relatively rare in vertebrates (Eens & Pinxten 2000) and thus our overall results are unlikely to be affected.

We find that there has only been very limited adaptive directional evolution in testes mass during the course of vertebrate evolutionary history. In birds only, rapid rates of testes mass change (i.e. where path-wise rates are largest, see Methods) have overwhelmingly been towards smaller mass in the social mating system where sperm competition has been lowest: monogamy. We observe no such association in any other vertebrate group. This means that after an initial increase in size associated with the evolution of social polyandry, there has been no strong pressure *within* socially polyandrous species driving continued increases. This lack of continued adaptation suggests that there has not been increasing levels of sperm competition within groups over time**.** Additionally, non-directionality in the evolution of testes mass of socially polyandrous vertebrates may be owing to the different types of polyandry observed in nature. Simultaneous polyandry, where a female produces a single brood after mating with multiple males would predict very high levels of sperm competition whereas sequential polyandry, where a female produces a brood with multiple males one after the other may predict relatively less – though sperm competition can still be very high in these species owing to sperm storage (Møller 1988; Oring *et al.* 1992).

One obvious reason for the observed differences between monogamous birds and other vertebrates is that flight restricts the available energy budget to birds (Butler & Bishop 2000). Any opportunity to reduce investment in expensive tissues (e.g. in the case of reduced sperm competition) may have been advantageous in such a scenario. However, we find no significant directionality in testes mass change along the branches of bats – the only other group of flighted vertebrates ($N = 49$, $p = 0.71$), so this explanation seems unlikely. An alternative explanation is the overall prevalence of monogamy in birds. Over 75% of all bird species are socially monogamous (Mock & Fujioka 1990; Dunn *et al.* 2001; Lukas & Clutton-Brock 2013), and although social monogamy does exist in other vertebrates (Bull 2000; Whiteman & Côté 2004; Lukas & Clutton-Brock 2013), it tends to be much rarer (Mock & Fujioka 1990; Bull 2000). Frogs also have high levels of monogamy (Liao *et al.* 2011) (88% in our dataset, Table S1), but most species are external fertilizers (Beck 1998), which imposes a unique set of selection pressures on testes compared with species with internal fertilization (Parker 2014). The prevalence of single-partner mating systems in combination with internal fertilization in birds may have increased opportunity for the evolution of diverse behaviours and morphologies where investment in testes mass are less important (Parker 2014; Parker 2016). Sexual traits used for mate acquisition such as ornamentation or weapons have been shown to be more important investments than testes mass in several animal groups (Simmons & Emlen 2006; Fitzpatrick *et al.* 2012; Buzatto *et al.* 2015; Dines *et al.* 2015; Dunn *et al.* 2015) – although these tend to be associated with polygynous or lekking mating systems (Møller & Pomiankowski 1993; Savalli 1995). It therefore warrants further investigation to reveal whether any costly traits in particular are more prevalent in monogamous birds than those of other mating systems.

In general, a negative relationship between testes mass and its rate of evolution such as the one we find here for monogamous birds could imply a trade-off between testes and other behaviours (see above). Trade-offs between expensive organs like testes, brains, and guts are predicted by the expensive-tissue hypothesis (Aiello & Wheeler 1995; Isler & van Schaik 2006) although there has been little evidence for this in testes (e.g. Schillaci 2006; Lemaître *et al.* 2009; Bordes *et al.* 2011; Kelley *et al.* 2014). However, at least across species, it may be difficult to observe trade-offs owing to the numerous potential morphologies, physiologies, and behaviours that have the potential to trade-off with testes at macroevolutionary scales (Lüpold *et al.* 2014; Somjee *et al.* 2018). An alternative explanation for such a negative relationship might be a continued reduction in the level of sperm competition (by some unknown mechanism) observed in monogamous species over time. Whilst an interesting concept – it implies increased specialization to monogamous mating systems – this remains difficult to test in the face of present data. It is also hard to imagine that the level of sperm competition has continually decreased in monogamous birds over time when we consider the fact that there is variation in the level of sperm competition faced by monogamous species (Griffith *et al.* 2002; Ophir *et al.* 2008; Biagolini-Jr *et al.* 2017).

The fact that monogamous species are increasingly shown to face sperm competition and vary in their level of extra-pair paternity has led to a general acceptance that social and genetic mating systems may not directly correlate among different animal groups (DeWoody & Avise 2001; Griffith *et al.* 2002; Clutton-Brock & Isvaran 2006; Isvaran & Clutton-Brock 2006; Ophir *et al.* 2008; Biagolini-Jr *et al.* 2017).

An explicit empirical link between sperm competition and social mating system across vertebrates is desirable, though we currently lack the data to show this at large scales. This is owing to the fact most genetic data measures extra-pair paternity (EPP) (e.g. Griffith *et al.* 2002; Biagolini-Jr *et al.* 2017) which, is not clearly comparable to paternity within social systems comprising multiple partners. The proportion of offspring sired by a male outside a social group (i.e. extra-group paternity) (e.g. Westneat & Stewart 2003), is not comparable to EPP and actually tells us very little in terms of sperm competition – it would be better to measure the number of offspring fathered by the non-dominant male (e.g. Møller & Briskie 1995). Per-brood measures of multiple-paternity such as number of sires per brood (Rowley *et al.* 2018) or the frequency of broods with mixed paternity (Taylor *et al.* 2014; Biagolini-Jr *et al.* 2017; Rowley *et al.* 2018) can also give us an indication of sperm competition but are not without their problems. For example, the frequency of extra-pair copulations does not correlate with the frequency of extra-pair fertilization in pair-bonded species (Birkhead & Møller 1995) and it is unclear whether "mixed paternity" can be measurable or meaningful in species which routinely produce only a single offspring per clutch/brood. In any case, most studies identify variation in multiple-paternity within socially monogamous species (reviewed in Griffith *et al.* 2002) – but this amounts to, on average, only 11% of all offspring being sired by a male that is not the social parent (Griffith *et al.* 2002), at least within birds.

Social mating system is still a reasonable proxy for the *relative* amount of sperm competition faced by species. Social monogamy clearly does not eliminate sperm competition but rather there is less scope for sperm competition compared with social polyandry. This has been shown in mammals, where socially monogamous species have significantly lower multiple paternity rates than those with multi-male social systems (Soulsbury 2010). Sociality and mating system are also significantly linked to the occurrence of multiple-mating by female birds (Møller & Birkhead 1993). Distinct social mating systems have also been maintained in an evolutionary sense and are repeatedly linked to testes size in many animal groups (e.g. Harcourt *et al.* 1981; Jennions & Passmore 1993; Parker *et al.* 1997; Pitcher *et al.* 2005) (also supported here across vertebrates, Figure 4). The fact that there is also an association between different genetic measures of multiple paternity and testes size across vertebrates (e.g. Møller & Briskie 1995;

Ramm *et al.* 2005; Rowley *et al.* 2018) makes it almost impossible to imagine a scenario where social mating system provides no information on the relative amount of sperm competition faced by species.

Sperm competition clearly has an important role in driving changes in testes mass (Harcourt *et al.* 1981; Gage 1994; Møller & Briskie 1995; Hosken 1997; Parker *et al.* 1997; Birkhead & Møller 1998) (Figure 4), but exactly how changes in social mating system can explain the radiations of testes mass diversity that we see across vertebrates (Figure 3) remains unclear, and warrants further investigation. We hope that our results will inspire researchers to investigate what factors might have been driving the strong selection on relative testes mass that manifest as rapid bursts of evolutionary change during the course of vertebrate history. For example, as more data on both testes mass and mating systems become available in other groups, it may be possible to reveal nuances in the evolution of relative testes mass that are currently otherwise impossible. Factors such as geography, dispersion, mating rates, or migratory behaviour (Dunn *et al.* 2001; Pitcher *et al.* 2005; Vahed & Parker 2012), etc. may also have played key roles in driving bursts of testes mass change.

Many radiations of testes mass diversity (Figure 3, Table S2) have punctuated the last 400 million years of vertebrate evolutionary history. These radiations reveal clades in the vertebrate phylogeny where there has been intense adaptive change in testes mass. However, in most vertebrates, these adaptive bursts of testes mass evolution have not led to any sustained directional changes (Figure 4). In socially monogamous birds only, we observe adaptive reductions in testes mass that almost certainly arise from a combination of different factors and trade-offs. One key outcome of our analysis is that we highlight a novel opportunity to reveal historical trends in traits after considering the effect of other factors such as body mass. Soft tissues like testes are often preserved poorly in the fossil record (Brusatte 2012), and we reveal patterns and processes of evolution that occurred deep in time that may otherwise have been impossible to detect.

Acknowledgements

This work was supported by a University of Reading PhD Studentship and a Leverhulme Early Career Fellowship (ECF-2017-022) to JB, two Leverhulme Trust Research Project Grants (RPG-2013-185 and RPG-2017-071) to CV and a BBSRC Research Grant to AM (BB/L018594/1). We thank Ciara O'Donovan and Manabu Sakamoto for helpful discussions regarding this work. We also thank Peter Dunn for providing us details and data for some bird species.

References

1. Aiello, L.C. & Wheeler, P. (1995). The expensive-tissue hypothesis: the brain and the digestive system in human and primate evolution. *Curr Anthropol*, 36, 199-221.

2. Baker, J., Meade, A., Pagel, M. & Venditti, C. (2015). Adaptive evolution toward larger size in mammals. *Proc Natl Acad Sci U S A*, 112, 5093-5098.

3. Baker, J., Meade, A., Pagel, M. & Venditti, C. (2016). Positive phenotypic selection inferred from phylogenies. *Biol J Linn Soc*, 118, 95-115.

4. Baker, J. & Venditti, C. (2019). Rapid change in mammalian eye shape is explained by activity pattern. *Curr Biol*, 29, 1082-1088.

5. Beck, C.W. (1998). Mode of fertilization and parental care in anurans. *Anim Behav*, 55, 439-449.

6. Berglund, A. & Rosenqvist, G. (2003). Sex role reversal in pipefish. *Adv Study Behav*, 32, 131-168.

7. Biagolini-Jr, C., Westneat, D.F. & Francisco, M.R. (2017). Does habitat structural complexity influence the frequency of extra-pair paternity in birds? *Behav Ecol Sociobiol*, 71, 101.

8. Birkhead, T. & Møller, A. (1995). Extra-pair copulation and extra-pair paternity in birds. *Anim Behav*, 49, 843-848.

9. Birkhead, T.R. & Møller, A.P. (1992). *Sperm competition in birds. Evolutionary causes and consequences*. Academic Press, San Diego, California (USA).

10. Birkhead, T.R. & Møller, A.P. (1998). *Sperm competition and sexual selection*. Academic Press, San Diego, California (USA).

11. Bordes, F., Morand, S. & Krasnov, B.R. (2011). Does investment into “expensive” tissue compromise anti-parasitic defence? Testes size, brain size and parasite diversity in rodent hosts. *Oecologia*, 165, 7-16.

12. Breed, W.G. & Jason, T. (2000). Body mass, testes mass, and sperm size in murine rodents. *J Mammal*, 81, 758-768.

13. Brusatte, S.L. (2012). *Dinosaur paleobiology*. Wiley-Blackwell, New Jersey, USA.

14. Bull, C.M. (2000). Monogamy in lizards. *Behav Processes*, 51, 7-20.

15. Butler, P.J. & Bishop, C.M. (2000). Flight. In: *Sturkie's Avian Physiology* (ed. Whittow, GC). Academic Press New York, NY.

16. Buzatto, B.A., Roberts, J.D. & Simmons, L.W. (2015). Sperm competition and the evolution of precopulatory weapons: Increasing male density promotes sperm competition and reduces selection on arm strength in a chorusing frog. *Evolution*, 69, 2613-2624.

17. Byrne, P.G., Roberts, J.D. & Simmons, L.W. (2002). Sperm competition selects for increased testes mass in Australian frogs. *J Evol Biol*, 15, 347-355.

18. Byrne, P.G. & Whiting, M.J. (2011). Effects of simultaneous polyandry on offspring fitness in an African tree frog. *Behav Ecol*, 22, 385-391.

19. Clutton-Brock, T.H. & Isvaran, K. (2006). Paternity loss in contrasting mammalian societies. *Biol Lett*, 2, 513-516.

20. DeWoody, J.A. & Avise, J.C. (2001). Genetic Perspectives on the Natural History of Fish Mating Systems. *J Hered*, 92, 167-172.

21. Dines, J.P., Mesnick, S.L., Ralls, K., May-Collado, L., Agnarsson, I. & Dean, M.D. (2015). A trade-off between precopulatory and postcopulatory trait investment in male cetaceans. *Evolution*, 69, 1560-1572.

22. Dunn, J.C., Halenar, L.B., Davies, T.G., Cristobal-Azkarate, J., Reby, D., Sykes, D. *et al.* (2015). Evolutionary trade-off between vocal tract and testes dimensions in howler monkeys. *Curr Biol*, 25, 2839-2844.

23. Dunn, P.O., Whittingham, L.A. & Pitcher, T.E. (2001). Mating systems, sperm competition, and the evolution of sexual dimorphism in birds. *Evolution*, 55, 161-175.

24. Eens, M. & Pinxten, R. (2000). Sex-role reversal in vertebrates: behavioural and endocrinological accounts. *Behav Processes*, 51, 135-147.

25. Fitzpatrick, J.L., Almbro, M., Gonzalez-Voyer, A., Kolm, N. & Simmons, L.W. (2012). Male contest competition and the coevolution of weaponry and testes in pinnipeds. *Evolution*, 66, 3595-3604.

26. Freckleton, R.P. & Watkinson, A.R. (2001). Nonmanipulative determination of plant community dynamics. *Trends Ecol Evol*, 16, 301-307.

27. Gage, M.J. (1994). Associations between body size, mating pattern, testis size and sperm lengths across butterflies. *Proc R Soc Lond B Biol Sci*, 258, 247-254.

28. Griffith, S.C., Owens, I.P.F. & Thuman, K.A. (2002). Extra pair paternity in birds: a review of interspecific variation and adaptive function. *Mol Ecol*, 11, 2195-2212.

29. Harcourt, A.H., Harvey, P.H., Larson, S.G. & Short, R. (1981). Testis weight, body weight and breeding system in primates. *Nature*, 293, 55-57.

30. Hasselquist, D. & Sherman, P.W. (2001). Social mating systems and extrapair fertilizations in passerine birds. *Behav Ecol*, 12, 457-466.

31. Hayward, A. & Gillooly, J.F. (2011). The cost of sex: Quantifying energetic investment in gamete production by males and females. *PLoS ONE*, 6, e16557.

32. Hedges, S.B., Marin, J., Suleski, M., Paymer, M. & Kumar, S. (2015). Tree of life reveals clock-like speciation and diversification. *Mol Biol Evol*, 32, 835-845.

33. Hosken, D. & Ward, P. (2001). Experimental evidence for testis size evolution via sperm competition. *Ecol Lett*, 4, 10-13.

34. Hosken, D.J. (1997). Sperm competition in bats. *Proc R Soc Lond B Biol Sci*, 264, 385-392.

35. Hosken, D.J. (1998). Testes mass in megachiropteran bats varies in accordance with sperm competition theory. *Behav Ecol Sociobiol*, 44, 169-177.

36. Iossa, G., Soulsbury, C.D., Baker, P.J. & Harris, S. (2008). Sperm competition and the evolution of testes size in terrestrial mammalian carnivores. *Funct Ecol*, 22, 655-662.

37. Isler, K. & van Schaik, C. (2006). Costs of encephalization: the energy trade-off hypothesis tested on birds. *J Hum Evol*, 51, 228-243.

38. Isvaran, K. & Clutton-Brock, T. (2006). Ecological correlates of extra-group paternity in mammals. *Proc R Soc Lond B Biol Sci*, 274, 219-224.

39. Jennions, M.D. & Passmore, N.I. (1993). Sperm competition in frogs: testis size and a 'sterile male' experiment on *Chiromantis xerampelina* (Rhacophoridae). *Biol J Linn Soc*, 50, 211-220.

40. Kelley, T.C., Higdon, J.W. & Ferguson, S.H. (2014). Large testes and brain sizes in odontocetes (order Cetacea, suborder Odontoceti): the influence of mating system on encephalization. *Can J Zool*, 92, 721-726.

41. Kvarnemo, C. & Simmons, L.W. (2004). Testes investment and spawning mode in pipefishes and seahorses (Syngnathidae). *Biol J Linn Soc*, 83, 369-376.

42. Lemaître, J.F., Ramm, S.A., Barton, R.A. & Stockley, P. (2009). Sperm competition and brain size evolution in mammals. *J Evol Biol*, 22, 2215-2221.

43. Liao, W.B., Mi, Z.P., Zhou, C.Q., Jin, L., Lou, S.L., Han, X. *et al.* (2011). Relative testis size and mating systems in anurans: large testis in multiple-male mating in foam-nesting frogs. *Anim Biol*, 61, 225-238.

44. Lukas, D. & Clutton-Brock, T.H. (2013). The evolution of social monogamy in mammals. *Science*, 341, 526-530.

45. Lüpold, S., Tomkins, J.L., Simmons, L.W. & Fitzpatrick, J.L. (2014). Female monopolization mediates the relationship between pre-and postcopulatory sexual traits. *Nat Commun*, 5, 3184.

46. MacLeod, C.D. & MacLeod, R. (2009). The relationship between body mass and relative investment in testes mass in amniotes and other vertebrates. *Oikos*, 118, 903-916.

47. Meerlo, P., Bolle, L., Visser, G.H., Masman, D. & Daan, S. (1997). Basal metabolic rate in relation to body composition and daily energy expenditure in the field vole, Microtus agrestis. *Physiol Zool*, 70, 362-369.

48. Mock, D.W. & Fujioka, M. (1990). Monogamy and long-term pair bonding in vertebrates. *Trends Ecol Evol*, 5, 39-43.

49. Møller, A. & Birkhead, T. (1993). Cuckoldry and sociality: a comparative study of birds. *Am Nat*, 142, 118-140.

50. Møller, A. & Briskie, J. (1995). Extra-pair paternity, sperm competition and the evolution of testis size in birds. *Behav Ecol Sociobiol*, 36, 357-365.

51. Møller, A.P. (1988). Testes size, ejaculate quality and sperm competition in birds. *Biol J Linn Soc*, 33, 273-283.

52. Møller, A.P. (1989). Ejaculate quality, testes size and sperm production in mammals. *Funct Ecol*, 3, 91-96.

53. Møller, A.P. (1992). Frequency of female copulations with multiple males and sexual selection. *Am Nat*, 139, 1089-1101.

54. Møller, A.P. (2000). Male parental care, female reproductive success, and extrapair paternity. *Behav Ecol*, 11, 161-168.

55. Møller, A.P. & Pomiankowski, A. (1993). Why have birds got multiple sexual ornaments? *Behav Ecol Sociobiol*, 32, 167-176.

56. Ophir, A.G., Phelps, S.M., Sorin, A.B. & Wolff, J.O. (2008). Social but not genetic monogamy is associated with greater breeding success in prairie voles. *Anim Behav*, 75, 1143-1154.

57. Oring, L.W., Fleischer, R.C., Reed, J.M. & Marsden, K.E. (1992). Cuckoldry through stored sperm in the sequentially polyandrous spotted sandpiper. *Nature*, 359, 631-633.

58. Pagel, M. (1999). Inferring the historical patterns of biological evolution. *Nature*, 401, 877-884.

59. Pagel, M., Meade, A. & Barker, D. (2004). Bayesian estimation of ancestral character states on phylogenies. *Syst Biol*, 53, 673-684.

60. Parker, G., Ball, M., Stockley, P. & Gage, M. (1997). Sperm competition games: a prospective analysis of risk assessment. *Proc R Soc Lond B Biol Sci*, 264, 1793-1802.

61. Parker, G.A. (1970). Sperm competition and its evolutionary consequences in the insects. *Biological Reviews*, 45, 525-567.

62. Parker, G.A. (2014). The sexual cascade and the rise of pre-ejaculatory (Darwinian) sexual selection, sex roles, and sexual conflict. *Cold Spring Harbor perspectives in biology*, 6, a017509.

63. Parker, G.A. (2016). The evolution of expenditure on testes. *J Zool*, 298, 3-19.

64. Parker, G.A. & Pizzari, T. (2010). Sperm competition and ejaculate economics. *Biological Reviews*, 85, 897-934.

65. Peters, R.H. (1986). *The ecological implications of body size*. Cambridge University Press, Cambridge, UK.

66. Pitcher, T., Dunn, P. & Whittingham, L. (2005). Sperm competition and the evolution of testes size in birds. *J Evol Biol*, 18, 557-567.

67. Pitnick, S., Jones, K.E. & Wilkinson, G.S. (2006). Mating system and brain size in bats. *Proc R Soc Lond B Biol Sci*, 273, 719-724.

68. Raftery, A.E. (1996). Hypothesis testing and model selection. In: *In: Markov Chain Monte Carlo in practice* (eds. Gilks, WR, Richardson, S & Spiegelhalter, DJ). Chapman & Hall London, UK, pp. Pages 163-187.

69. Ramm, S.A., Parker, G.A. & Stockley, P. (2005). Sperm competition and the evolution of male reproductive anatomy in rodents. *Proc R Soc Lond B Biol Sci*, 272, 949-955.

70. Ribble, D.O. (1991). The monogamous mating system of *Peromyscus californicus* as revealed by DNA fingerprinting. *Behav Ecol Sociobiol*, 29, 161-166.

71. Roberts, J.D. & Byrne, P.G. (2011). Polyandry, sperm competition, and the evolution of anuran amphibians. In: *Advances in the Study of Behavior*. Elsevier, pp. 1-53.

72. Rose, E., Paczolt, K.A. & Jones, A.G. (2013). The contributions of premating and postmating selection episodes to total selection in sex-role-reversed Gulf pipefish. *Am Nat*, 182, 410-420.

73. Rowley, A.G., Daly-Engel, T.S. & Fitzpatrick, J.L. (2018). Testes size increases with sperm competition risk and intensity in bony fish and sharks. *Behav Ecol*, 30, 364-371.

74. Savalli, U.M. (1995). The evolution of bird coloration and plumage elaboration. In: *Current ornithology*. Springer, pp. 141-190.

75. Schillaci, M.A. (2006). Sexual selection and the evolution of brain size in primates. *PLoS ONE*, 1, e62.

76. Schulte-Hostedde, A.I. & Millar, J.S. (2004). Intraspecific variation of testis size and sperm length in the yellow-pine chipmunk (*Tamias amoenus*): implications for sperm competition and reproductive success. *Behav Ecol Sociobiol*, 55, 272-277.

77. Schulte-Hostedde, A.I., Millar, J.S. & Hickling, G.J. (2005). Condition dependence of testis size in small mammals. *Evol Ecol Res*, 7, 143-149.

78. Simmons, L.W. & Emlen, D.J. (2006). Evolutionary trade-off between weapons and testes. *Proc Natl Acad Sci U S A*, 103, 16346-16351.

79. Simmons, L.W. & García-González, F. (2008). Evolutionary reduction in testes size and competitive fertilization success in response to the experimental removal of sexual selection in dung beetles. *Evolution*, 62, 2580-2591.

80. Smith, R.L. (1984). *Sperm competition and the evolution of animal mating systems*. Academic Press Inc, Orlando, Florida.

81. Somjee, U., Miller, C., Tatarnic, N. & Simmons, L. (2018). Experimental manipulation reveals a trade-off between weapons and testes. *J Evol Biol*, 31, 57-65.

82. Soulsbury, C.D. (2010). Genetic patterns of paternity and testes size in mammals. *PLoS ONE*, 5, e9581.

83. Stockley, P., Gage, M.J.G., Parker, G.A. & Møller, A.P. (1997). Sperm Competition in Fishes: The Evolution of Testis Size and Ejaculate Characteristics. *Am Nat*, 149, 933-954.

84. Taylor, M.L., Price, T.A. & Wedell, N. (2014). Polyandry in nature: a global analysis. *Trends Ecol Evol*, 29, 376-383.

85. Vahed, K. & Parker, D.J. (2012). The evolution of large testes: sperm competition or male mating rate? *Ethology*, 118, 107-117.

86. Venditti, C., Meade, A. & Pagel, M. (2011). Multiple routes to mammalian diversity. *Nature*, 479, 393-396.

87. Westneat, D.F. & Stewart, I.R. (2003). Extra-pair paternity in birds: causes, correlates, and conflict. *Annual Review of Ecology, Evolution, and Systematics*, 34, 365-396.

88. Whiteman, E.A. & Côté, I.M. (2004). Monogamy in marine fishes. *Biological Reviews*, 79, 351-375.

89. Xie, W., Lewis, P.O., Fan, Y., Kuo, L. & Chen, M.-H. (2010). Improving marginal likelihood estimation for Bayesian phylogenetic model selection. *Syst Biol*, 60, 150-160.

Figure Legends

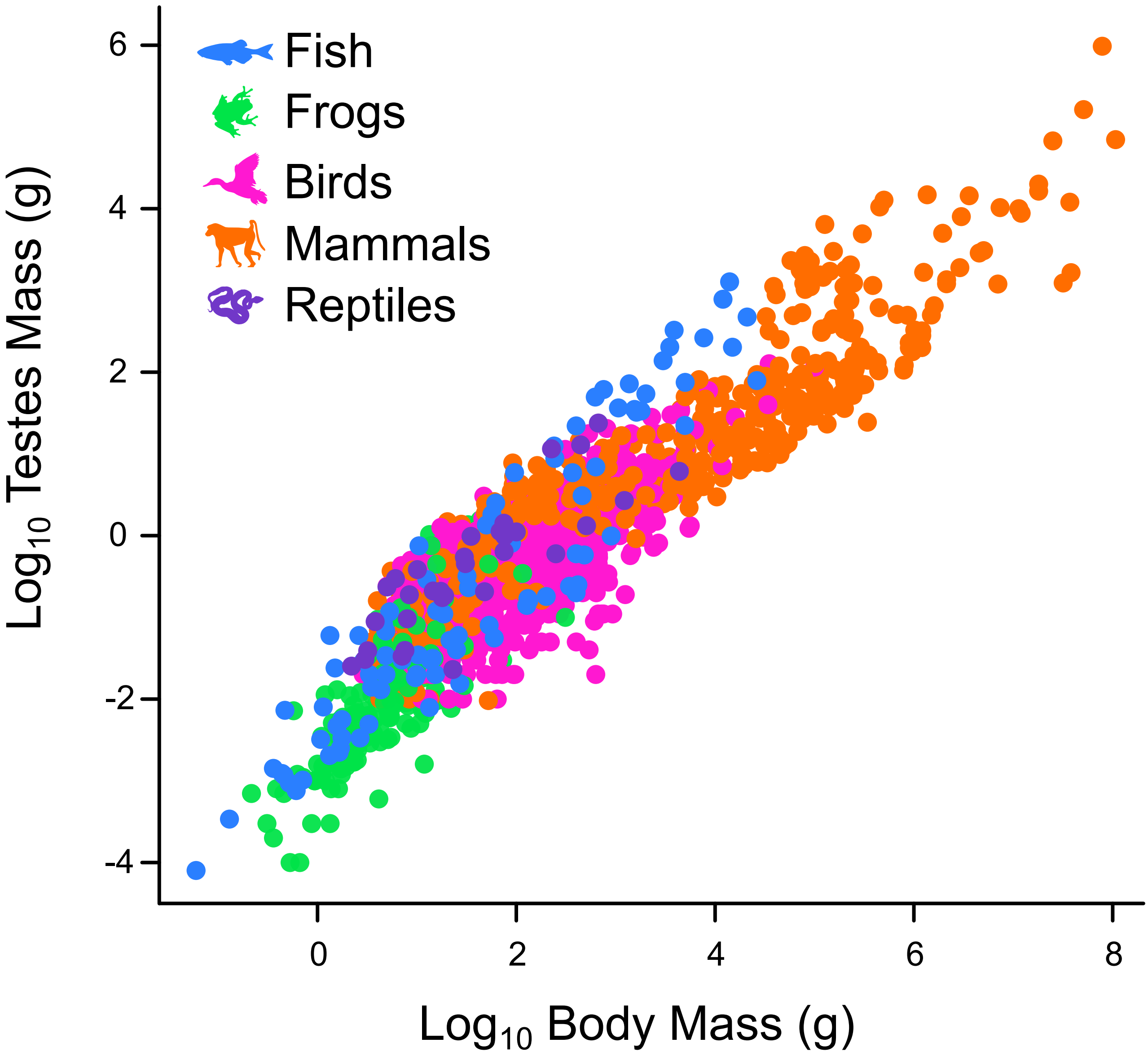
Figure 1: Testes size and body size for 1,913 vertebrate species. Testes mass is highly variable even after accounting for body mass: in a maximum likelihood phylogenetic generalized least squares (GLS) regression model across this data, r^2 = 0.21. All silhouettes are taken from phylopic.org.

Figure 2: Testes mass allometry in vertebrates. (A) The posterior distribution of regression coefficients (slopes) inferred from our variable rates regression model estimating the relationship between testes mass and body mass for each of the five major vertebrate classes. Inset: The posterior distribution of intercepts for each group. Colours link to silhouettes in both (B) and (C) which shows post-hoc pairwise comparisons assessing the posterior distribution of the differences between each pair of estimated parameters. In (B) values represent the proportion of the posterior distribution of differences that cross zero, $P_{x[diff]}$ and in (B) values represent mean differences. In both (B) and (C), the upper right half of the table shaded in grey shows values for intercepts and the lower left half shows values for slopes. The sample size for each group is shown along the diagonal. All silhouettes are taken from phylopic.org.

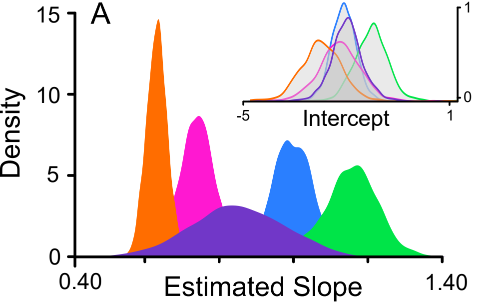
Figure 3: Heritable rate shifts in the rate of testes size evolution across the vertebrate phylogeny representing increases in testes mass diversity (each colour represents a unique shift). In (A-K) we show the distribution of σ_v^2 (optimized rate per branch) along the branch leading to each clade compared to the distribution of σ_v^2 along the immediately ancestral branch. The colours of each distribution correspond to the branch colours on the phylogeny (L). Silhouettes indicate the branch leading to each of the five major vertebrate clades and are taken from phylopic.org. We find heritable rate shifts in all major clades studied with the exception of reptiles: (A) Within mammals [Subclass Theria: N = 618]. (B) Within frogs [Superfamily Hyloidea + Family Myobatrachidae: N = 126] (C) Within fish [Order Perciformes: N = 26]. (D) Within birds [Neognathae: N = 979]. (E) Within mammals [Order Cetacea: N = 58]. (F) Within frogs [Genera Rana + Odorrana: N = 11]. (G) Within fish [Family Syngnathidae: N = 12]. (H) Within birds [Order Chararadriiformes: N = 18]. (I) Within mammals [Genus Pseudomys: N = 10]. (J) Within frogs [Families Dicroglossidae and Rhacophoridae: N = 19]. (K) Within fish [Cyprinidae: N = 22].

For more detailed descriptions of each clade, see Table S2. In (M) distributions from (A-K) are shown on a single plot for comparison.

Figure 4: The effect of social mating system (MS) and the rate of morphological evolution on vertebrate testes sizes. (A) Differences between predicted testes mass (using the parameters of our regression model) of polyandrous/polygynandrous (PA, closed circles), polygynous (PG, lightly shaded circles), and monogamous (M, open circles) species given the average body mass within fish (523.60 g), frogs (11.46 g), and mammals (1548.82 g). (B) Rapid shifts in the rate of evolution give rise to an overwhelming tendency for testes mass reduction in monogamous birds (pink line). The relationship is non-significant in birds of other social mating systems (grey lines and silhouettes). Differences in relative testes mass are visualized in (B) and (C); circles represent the predicted testes mass in proportion to the area of the animal silhouette assuming that it represents the average body mass. Each silhouette is identical in area. For an average-sized (891.25 g) monogamous bird, we calculate the potential magnitude of adaptive testes reduction by predicting testes mass (white circles in (B)) given the smallest path-wise rate (10.23g) and the largest path-wise rate (0.11g, black arrow). Average body sizes are calculated using phylogenetic GLS models [4]. In (D) we show post-hoc pairwise comparisons assessing the difference in average testes mass among different mating systems. The estimated intercept differences are shown by the upper right half of the table, shaded in grey (where a value is positive, it indicates that the column-wise mating system is larger). The p-value for this difference is shown in the lower left half of the table. Sample size for each group is shown along the diagonal. For frogs, we only have data on monandry/polyandry. For birds, pair-wise differences from monogamous species are not comparable owing to the significant estimated slope. All silhouettes are taken from phylopic.org.



Fish
Frogs
Birds
Mammals
Reptiles
6
4
2
0
-2
-4
0
2
4
6
8
Log_{10} Testes Mass (g)
Log_{10} Body Mass (g)

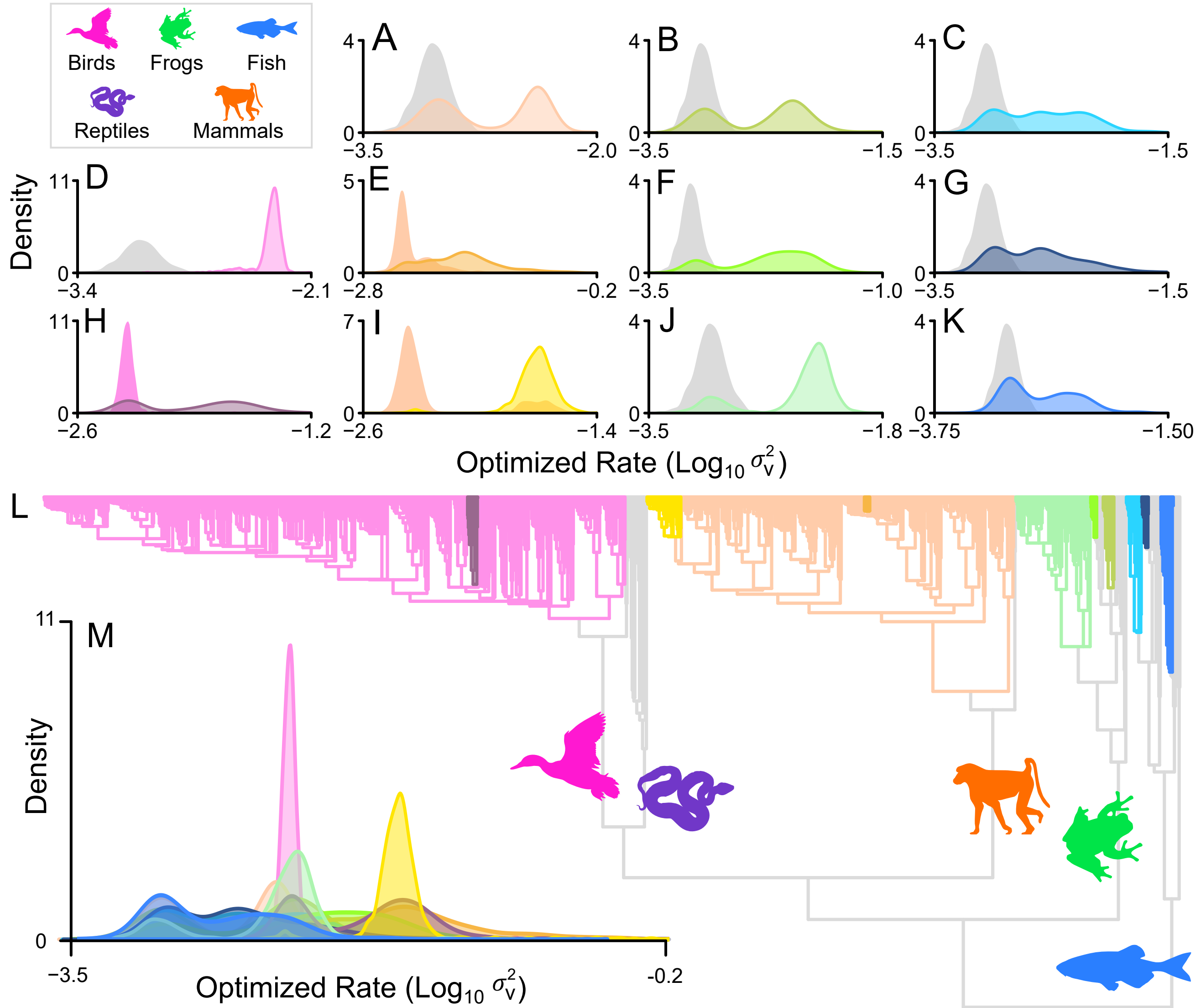


B

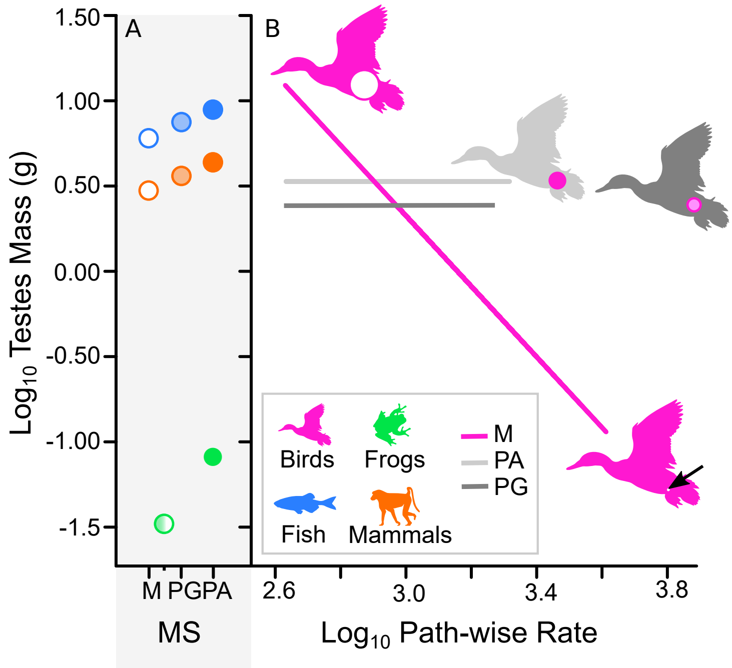
Px[diff]					
Fish	N = 91	0.11	0.45	0.17	0.42
Frogs	0.04	N = 186	0.10	0.21	0.14
Birds	0.00	0.00	N = 983	0.17	0.35
Mammals	0.00	0.00	0.02	N = 621	0.11
Reptiles	0.10	0.01	0.21	0.05	N = 32

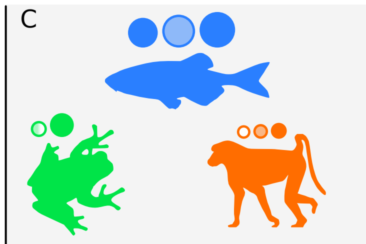
C

diff					
	N = 91	-0.84	0.12	0.68	-0.09
	-0.16	N = 186	0.96	1.52	0.75
	0.26	0.41	N = 983	0.56	-0.21
	0.37	0.52	0.11	N = 621	-0.77
	0.15	0.30	-0.11	-0.22	N = 32



Birds
Frogs
Fish
Reptiles
Mammals
A
B
C
D
E
F
G
H
I
J
K
Density
Optimized Rate (Log$_{10}$ σ_v^2)
L
M
Density
Optimized Rate (Log$_{10}$ σ_v^2)





D

		M	PG	PA
Fish	M	N = 15	-0.10	-0.17
	PG	0.61	N = 8	-0.07
	PA	0.05	0.72	N = 40
Frogs	M, PG	N = 149		0.40
	PA	<0.01		N = 20
Birds	M	N = 705	n/a	n/a
	PG	n/a	N = 116	-0.14
	PA	n/a	0.09	N = 24
Mammals	M	N = 50	-0.09	-0.17
	PG	0.16	N = 99	-0.08
	PA	<0.01	0.01	N = 209

Supplementary Text

Testes mass and body mass data

We collected testes mass and body mass for vertebrate species from the literature, prioritizing data from sources that contained data for multiple species, and supplementing data for individual species. To avoid conflicts among datasets, we enforced a standardized protocol to ensure a single measurement for each species.

Firstly, we preferred sources that directly measured testes mass and male body mass of individuals. Where a source was a literature compilation, we preferred those that attempted to obtain measurements from single individuals or, failing that, attempted to obtain testes and body mass of individuals from the same geographic regions (e.g. Kenagy & Trombulak 1986). Details on how this was achieved differs for individual datasets and so refer to the original sources for more information. Where single values represent multiple individuals or populations, we preferred mean values to maximums (only 29 species total come from a dataset that reports maximal testes mass). We placed low priority on values collected using data extraction software from images (e.g. Fitzpatrick et al. 2012) owing to possible user-associated error. Finally, if multiple sources fit the above criteria, we prioritized more recent datasets. We placed any ambiguous data sources at the end of the priority list. Where multiple datasets remained, we prioritized the dataset with the largest sample size (note that whilst using weighted means is an option, not all datasets provide sample size and using only a single source per taxa allowed us to apply a single protocol across all species and sources). Any sources that only contained testes mass (and no body mass) were included as the lowest priority, and were supplemented with body mass data from additional sources (N = 109 species in our final dataset, mostly within fish).

Our complete testes and body mass dataset comprised measurements for 1913 vertebrate species (91 fish, 186 frogs, 983 birds, 621 mammals, and 32 reptiles) collated from 92 different published sources – all data and references are recorded in Table S1.

We manually modified two values identified as errors as follows. Firstly, the California mouse (*Peromyscus californicus*) is erroneous in our preferred source (Soulsbury 2010), where it is reported to have 9.6g testes mass. This results from an incorrect unit conversion in the original cited source (Nelson et al. 1995), which we correct in our dataset (0.0096g). Secondly, the body mass of the laughing dove (*Streptopelia senegalensis*) was identified by Peter Dunn (personal communication) to be incorrect in our preferred source (Calhim & Birkhead 2007) which reports this species to be 584g. This large body mass also falls well outside the mass range of 66.8-101g reported in Dunning (2007). We adjusted the body mass of this species to 100.1g as reported in other published sources (Dunn et al. 2001; Pitcher et al. 2005).

Matching species names

We matched species to the vertebrate portion of the time tree of life (Hedges et al. 2015), checking for spellings and synonymy using major taxonomic resources (Species Survival Commision 2001; AmphibiaWeb 2005; Lepage 2009; Froese & Pauly 2012; BirdLife Taxonomic Working Group 2015; Roskov et al. 2016). To maximize our sample size, we incorporated species that did not match by genus matching. Where a species with testes mass data is the sole member of its genus found in the data, we substituted the data for that species with another member of the genus found in the phylogeny. We only did this where genera comprised monophyletic clades, and where it did not alter existing relationships among the species included in our dataset (Table S1).

Testes mass – Body mass allometry

We find differences in the slope of the relationship between testes mass and body mass for each of the major vertebrate clades, with the exception of reptiles (Figure 2). This is in line with recent analyses that find differences among animal groups (Hayward & Gillooly 2011), but in contrast with analyses that suggest that a single slope could explain most variation amongst amniotes (MacLeod & MacLeod 2009). This analysis suggested that there are differences in testes mass allometry for species of different body masses (MacLeod & MacLeod 2009; MacLeod 2014). That is, there is a single relationship across all species that differs not among taxonomic groups but instead over the range of observed body masses.

If the testes mass of large-, intermediate-, and small-bodied species (however these might be defined) differ in relative investment into testes mass independently and regardless of ancestry (MacLeod & MacLeod 2009; MacLeod 2014) then we should find a cubic relationship between testes mass and body mass (MacLeod 2014). To test this, we repeated our variable rates models but included an additional parameter that estimates a cubic curvature in the relationship. There is no support for the inclusion of a cubic parameter after considering the different testes mass – body mass relationships among the major vertebrate clades ($P_{[x]}$ = 0.126) that are supported by our main analyses.

Social mating system data

We collected social mating system data for species with testes mass and body mass data from the literature as a three-state categorical variable: monogamy, polygyny, and polyandry/polygynandry. We used the datasets from which we collected testes mass data in additional to several other compilations from the literature (see Table S1 for full reference list). We treated all sources of mating system data as equally valid; species-level classifications were therefore taken as that of the highest level of complexity (in increasing order from monogamy, through polygyny to polyandry/polygynandry). For example, a species classified as polyandrous in one dataset and polygynous in another would be defined here as "polyandrous/polygynandrous" whereas species classified as monogamous and polygynous in different datasets would be considered here as polygynous. In the absence of other information, several sources were excluded owing to a lack of clearly defined social mating system: e.g those which simply classify species as "non-monogamous" (Lukas & Clutton-Brock 2012; Lukas & Clutton-Brock 2013) or those which only provide details on female mating system (polyandry or monogamy/polygyny) (Anderson et al. 2004). To avoid discarding data, where possible, we combined these ambiguous sources to clearly deduce a mating system for a species that would otherwise lack classification: for example, in two different sources, *Rusa unicolor* (Sambar deer) is classified as female single-partner (Anderson et al. 2004) and as non-monogamous (Lukas & Clutton-Brock 2013). Combining these two mating systems gives a mating system of polyandrous, and so this species was classified as having a social mating system of polyandry/polygynandry.

Our complete testes, body mass, and social mating dataset comprised measurements for 63 fish, 169 frogs, 845 birds, and 358 mammals, collated from 77 different published sources – all data and references can be found in Table S1. Where required, additional details pertaining to collection of social mating system data for the major vertebrate groups can be found below.

Frogs

For frogs, most available mating system data comes from binary classifications (monandry or polyandry) and so for these species, we simplified our mating system categorization to these two categories only. There are still clear expectations for monandrous vs polyandrous testes masses. In (Byrne et al. (2002)) frogs are given a "sperm competition rank" where species ranked 0-3 are less likely to be multi-male than single male and 4 is polyandry. We define species with a sperm competition rank of 4 as polyandrous and all others as monandrous.

Fish

Group spawning is defined as promiscuous mating, whereas pair spawning tends to only involve a single male and single female (Johnston & Page 1992). We therefore define three "pair spawning" fish are defined as monogamous in the absence of further details*: Nocomis asper*, *N. leptocephalus*, and *N. micropogon* (Pyron *et al.* 2013). Although pair-spawning fish commonly have reproductive tactics and sneak-mating (Neff 2001) which make social mating systems difficult to identify, our results are identical if these three species are excluded from the analysis.

Note that our sample sizes for monogamous and polygynous fish were too small to analyse separately (N = 15 and N = 8 respectively). In our analysis that estimated a separate slope in the relationship between testes mass and path-wise rate for different mating systems, we therefore combined these two mating systems into a single category. As the slope is non-significant (see results), we estimated separate intercepts for all three mating systems – although we have very few polygynous species, it should still possible to estimate a mean (i.e., intercept difference).

Birds

In birds, 90 species are classified as belonging to a cooperative social mating system. Most cooperative breeders consist of a monogamous mating pair with additional related helpers (Hartley & Davies 1994). However, several cooperative breeders are known to have high levels of polyandry e.g. (Hartley & Davies 1994; Chao 1997). In many cases, cooperative mating systems were denoted simply as "cooperative" and thus it was unclear of the composition of social groups. Rather than include a category with mixed composition of social groups, we excluded these species from the analyses.

We identify 55 species as belonging to "lekking/promiscuous" social mating systems from several sources. Although it is suggested that sperm competition acts similarly within lekking species as it does for monogamous species (Garamszegi et al. 2005), we made no assumptions and instead defined social mating systems independently for these species (see Table S1 for sources). We excluded 12 lekking species for which we could not obtain more specific social mating system data; however, results do not differ if we consider these 12 species as either polygynous or polyandrous/polygynandrous.

Reptiles

To our knowledge, there is no compilation of mating system data readily available for squamates – at least not one that overlaps with our testes mass data. For these species, we collected data from individual sources (N = 12, see Table S1). However, we did not perform additional tests on these data owing to too small of a sample size.

Cross-validating the trend in monogamous birds

We ensure the consistency of our results by performing 100 independent cross-validation tests. To do this, we divide our dataset in two by randomly sampling 50% of all monogamous bird species. We then repeat our trends analysis in both halves of the dataset, estimating the relationship between testes mass and path-wise rate. We find that the significant negative relationship stands in both halves of 98% of all randomly re-sampled datasets (Figure S1). We are therefore confident in the robustness of our results across monogamous birds.

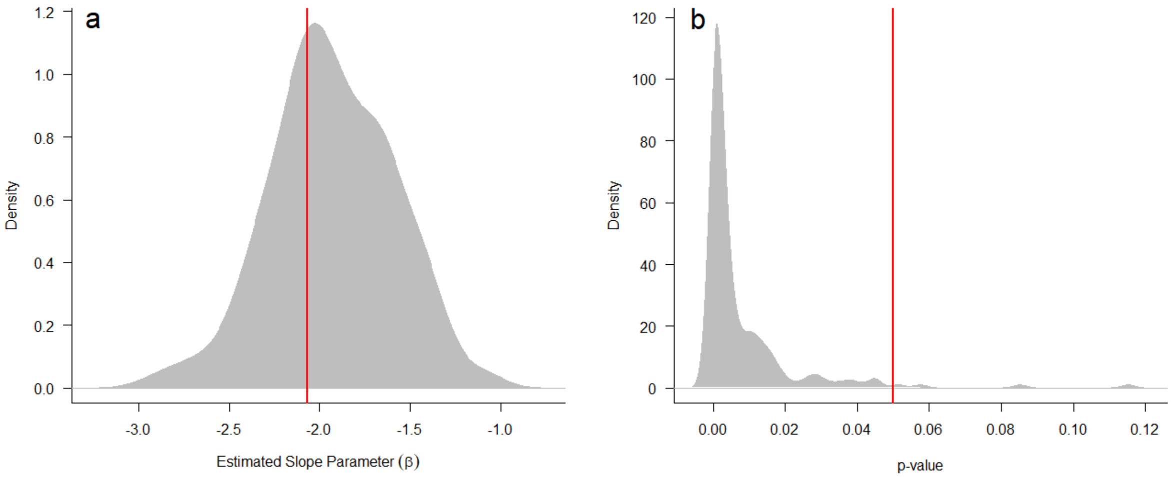


Figure S1 – The results of 100 cross-validation tests. The distribution of estimated β parameters (the slope value for the relationship between testes mass and path-wise rate) and its significance (p-value) are shown in (a) and (b) respectively. Values are shown for two datasets for each cross-validation test, generated by randomly re-sampling 50% of monogamous bird species (i.e. 200 models are presented in this figure). For reference, vertical lines are drawn at the slope value from the model in our main text that estimates a relationship across all monogamous birds in (a) and at p=0.05 in (b).

Running Variable Rates Regressions in BayesTraits V3

BayesTraits is a command-line driven program. The variable rates regression model requires the specification of both a tree file (this must be in nexus format) and a tab-delimited text file containing the data (full details on the structure of this data file and also the nexus phylogenetic tree file format can be found on pgs. 8-10 of the BayesTraits manual, available at: http://www.evolution.rdg.ac.uk/BayesTraitsV3.0.1/Files/BayesTraitsV3.Manual.pdf).

```
BayesTraitsV3.exe Tree.nexus Data.txt
```

After specifying a phylogenetic tree and dataset as above, options for the model choice are prompted on screen from which the user can select their desired option. In this case, we would see the options as shown below, and select option 9 as we are interested in running the fast-likelihood regression model (outlined on p. 8 of the manual with full instructions on p.42):

```
1)    MultiState
4)    Continuous: Random Walk (Model A)
5)    Continuous: Directional (Model B)
6)    Continuous: Regression
7)    Independent Contrast
8)    Independent Contrast: Correlation
9)    Independent Contrast: Regression
```

The program then prompts the user to specify whether they would prefer to use maximum likelihood or MCMC. In this case, we are interested in MCMC and so select option 2.

```
Please select the analysis method to use.
1)    Maximum Likelihood.
2)    MCMC
```

Optional model specifications are then entered manually according to the desired construct of the model. In this case, we want the variable rates model (p. 51- 52 of the manual), remove the first 500 thousand iterations as burn-in, sample 1 billion and 500 thousand iterations keeping only 500 thousandth sample (details of these options are on pages 16-17 of the manual). We want to estimate stepping stones using a total of 200 stones with 1 million iterations per stone (pg. 14). We then want to run this analysis (pgs. 8-10).

```
varrates
burnin 500000
iterations 1000500000
sample 500000
stones 200 1000000
run
```

A full list of all optional commands is provided in the manual with detailed descriptions of their function and specification.

References

1. AmphibiaWeb (2005). AmphibiaWeb: Information on amphibian biology and conservation. Available at: http://amphibiaweb.org/ Last accessed March 2016.
2. Anderson, M.J., Nyholt, J. & Dixson, A.F. (2004). Sperm competition affects the structure of the mammalian vas deferens. *J Zool*, 264, 97-103.
3. BirdLife Taxonomic Working Group (2015). BirdLife Taxonomic Checklist v8.0. Available at: http://www.birdlife.org/datazone/info/taxonomy Last accessed March 2016.
4. Byrne, P.G., Roberts, J.D. & Simmons, L.W. (2002). Sperm competition selects for increased testes mass in Australian frogs. *J Evol Biol*, 15, 347-355.
5. Calhim, S. & Birkhead, T.R. (2007). Testes size in birds: quality versus quantity - assumptions, errors, and estimates. *Behav Ecol*, 18, 271-275.
6. Chao, L. (1997). Evolution of polyandry in a communal breeding system. *Behav Ecol*, 8, 668-674.
7. Dunn, P.O., Whittingham, L.A. & Pitcher, T.E. (2001). Mating systems, sperm competition, and the evolution of sexual dimorphism in birds. *Evolution*, 55, 161-175.
8. Dunning, J.B. (2007). *CRC handbook of avian body masses*. 2nd edn. Taylor & Francis, Florida, USA.
9. Fitzpatrick, J.L., Almbro, M., Gonzalez-Voyer, A., Kolm, N. & Simmons, L.W. (2012). Male contest competition and the coevolution of weaponry and testes in pinnipeds. *Evolution*, 66, 3595-3604.
10. Froese, R. & Pauly, D. (2012). FishBase. Available at: http://www.fishbase.org Last accessed March 2016.
11. Garamszegi, L.Z., Eens, M., Hurtrez-Boussès, S. & Møller, A.P. (2005). Testosterone, testes size, and **mating success in birds: a comparative study. *Horm Behav*, 47, 389-409.**
12. Hartley, I.R. & Davies, N.B. (1994). Limits to Cooperative Polyandry in Birds. *Proc R Soc Lond [Biol]*, 257, 67-73.
13. Hayward, A. & Gillooly, J.F. (2011). The cost of sex: Quantifying energetic investment in gamete production by males and females. *PLoS ONE*, 6, e16557.
14. Hedges, S.B., Marin, J., Suleski, M., Paymer, M. & Kumar, S. (2015). Tree of life reveals clock-like speciation and diversification. *Mol Biol Evol*, 32, 835-845.
15. Johnston, C.E. & Page, L.M. (1992). The evolution of complex reproductive strategies in North American minnows (Cyprinidae). *Systematics, historical ecology, and North American freshwater fishes Stanford University Press, Stanford, California*, 600-621.
16. Kenagy, G. & Trombulak, S.C. (1986). Size and function of mammalian testes in relation to body size. *J Mammal*, 67, 1-22.
17. Lepage, D. (2009). Avibase–the world bird database. Available at: http://avibase.bsc-eoc.org Last accessed March 2016.
18. Lukas, D. & Clutton-Brock, T. (2012). Cooperative breeding and monogamy in mammalian societies. *Proc R Soc Lond B Biol Sci*, 279, 2151-2156.
19. Lukas, D. & Clutton-Brock, T.H. (2013). The evolution of social monogamy in mammals. *Science*, 341, 526-530.
20. MacLeod, C.D. (2014). Exploring and explaining complex allometric relationships: A case study on amniote testes mass allometry. *Systems*, 2, 379-392.
21. MacLeod, C.D. & MacLeod, R. (2009). The relationship between body mass and relative investment in testes mass in amniotes and other vertebrates. *Oikos*, 118, 903-916.
22. Neff, B.D. (2001). Alternative reproductive tactics and sexual selection. *Trends Ecol Evol*, 16, 669.
23. Nelson, R.J., Gubernick, D.J. & Blom, J.M. (1995). Influence of photoperiod, green food, and water availability on reproduction in male California mice (*Peromyscus californicus*). *Physiol Behav*, 57, 1175-1180.

24. Pitcher, T., Dunn, P. & Whittingham, L. (2005). Sperm competition and the evolution of testes size in birds. *J Evol Biol*, 18, 557-567.
25. Pyron, M., Pitcher, T. & Jacquemin, S. (2013). Evolution of mating systems and sexual size dimorphism in North American cyprinids. *Behav Ecol Sociobiol*, 67, 747-756.
26. Roskov, Y., Abucay, L., Orrell, T., Nicolson, D., Flann, C., Bailly, N. *et al.* (2016). Species 2000 & ITIS Catalogue of Life, 2016 Annual Checklist. Naturalis Leiden, the Netherlands.
27. Soulsbury, C.D. (2010). Genetic patterns of paternity and testes size in mammals. *PLoS ONE*, 5, e9581.
28. Species Survival Commision (2001). IUCN red list categories and criteria: version 3.1. *Prepared by the IUCN Species Survival Commission*.

Table S1: Dataset used for all analyses. Both testes mass (TM) and body mass (BM) are provided in units of log_{10} grams. Social mating systems (MS) are abbreviated as follows: C (cooperative), M (monogamous), PG (polygynous), PA (polyandrous), PGA (polygynandrous).

Species	***TM***	***Ref***	***BM***	***Ref***	***Notes***	***MS***	***Ref***
				Fish			
Coregonus_migratorius	1.875	Stockley 1997	3.699	FishBase	Original data is for Coregonus_peled - taxa included by genus matching.		
Doryrhamphus_excisus	-4.097	Kvarnemo 2004	-1.222	Kvarnemo 2004	Original data is for Doryrhamphus_negrosensis - taxa included by genus matching.		
Gila_conspersa	-0.538	Pyron 2013	1.101	Pyron 2013	Original data is for Gila_atraria - taxa included by genus matching.	PA/PGA	Pyron 2013
Hippichthys_penicillus	-3.027	Kvarnemo 2004	-0.284	Kvarnemo 2004	Original data is for Hippichthys_heptagonus - taxa included by genus matching.	M	Fishbase
Hippocampus_kelloggi	-1.738	Kvarnemo 2004	0.985	Kvarnemo 2004	Original data is for Hippocampus_angustus - taxa included by genus matching.	M	Fishbase
Lythrurus_roseipinnis	-2.097	Pyron 2013	0.058	Pyron 2013	Original data is for Lythrurus_bellus - taxa included by genus matching.	PA/PGA	Pyron 2013
Melanotaenia_sp._AC-2011	-2.493	Hayward 2011	0.032	Hayward 2011	Original data is for Melanotaenia_eachamensis - taxa included by genus matching.		
Oreochromis_andersonii	1.735	Stockley 1997	3.303	FishBase	Original data is for Oreochromis_aureus - taxa included by genus matching.	M	Stockley 1997
Solegnathus_hardwickii	-1.253	Kvarnemo 2004	1.778	Kvarnemo 2004	Original data is for Solegnathus_spinosissimus - taxa included by genus matching.		
Tilapia_guinasana	0.130	Liao 2018	1.699	Liao 2018	Original data is for Tilapia_zillii - taxa included by genus matching.	M	Stockley 1997
Acipenser_baerii	3.105	Liao 2018	4.146	FishBase		PA/PGA	Liao 2018

Acipenser_gueldenstaedtii	2.140	Liao 2018	3.477	Kvarnemo 2004	PA/PGA	Stockley 1997; Liao 2018
Acipenser_persicus	2.892	Liao 2018	4.079	Pyron 2013	PA/PGA	Liao 2018
Acipenser_ruthenus	1.563	Liao 2018	3.027	Kvarnemo 2004	PA/PGA	Liao 2018
Acipenser_stellatus	2.307	Liao 2018	3.544	Kvarnemo 2004	PA/PGA	Liao 2018
Acipenser_transmontanus	2.674	Liao 2018	4.322	Pyron 2013	PA/PGA	Stockley 1997; Liao 2018
Agosia_chrysogaster	-1.469	Pyron 2013	0.686	Hayward 2011	PA/PGA	Pyron 2013
Barbus_barbus	1.096	Liao 2018	2.380	FishBase	PA/PGA	Liao 2018
Bodianus_rufus	-0.745	Hayward 2011	2.301	Kvarnemo 2004	PG	Fishbase
Campostoma_ornatum	-1.854	Pyron 2013	0.544	Liao 2018	PA/PGA	Fishbase; Pyron 2013
Carassius_carassius	0.770	Liao 2018	2.566	Liao 2018	PA/PGA	Fishbase; Stockley 1997; Liao 2018
Clarias_gariepinus	0.840	Eyo 2014	2.800	Liao 2018	PA/PGA	Fishbase
Clepticus_parrae	-0.796	Hayward 2011	2.125	Liao 2018		
Clinostomus_funduloides	-1.081	Pyron 2013	0.664	Liao 2018	PA/PGA	Pyron 2013
Corythoichthys_intestinalis	-2.690	Kvarnemo 2004	0.121	Liao 2018	M	Fishbase
Cryptotomus_roseus	-1.699	Hayward 2011	0.688	Liao 2018	M	Fishbase

Ctenopharyngodon_idella	1.348	Liao 2018	3.696	Pyron 2013	PA/PGA	Stockley 1997; Liao 2018
Cyprinella_lutrensis	-1.699	Pyron 2013	0.523	Liao 2018	PA/PGA	Pyron 2013
Cyprinus_carpio	1.857	Liao 2018	3.137	Hayward 2011	PA/PGA	Stockley 1997; Liao 2018
Dunckerocampus_dactyliophorus	-2.600	Kvarnemo 2004	0.230	Pyron 2013		
Entelurus_aequoreus	-2.910	Kvarnemo 2004	-0.357	Liao 2018		
Esox_lucius	1.544	Liao 2018	3.189	Eyo 2014	PA/PGA	Stockley 1997; Liao 2018
Halicampus_grayi	-2.251	Kvarnemo 2004	0.246	Hayward 2011		
Halichoeres_bivittatus	-0.959	Hayward 2011	1.271	Pyron 2013		
Halichoeres_garnoti	-0.222	Hayward 2011	2.602	Kvarnemo 2004	M	Fishbase
Halichoeres_maculipinna	-1.398	Hayward 2011	1.398	Hayward 2011		
Halichoeres_pictus	-1.699	Hayward 2011	1.187	Liao 2018		
Halichoeres_poeyi	-1.222	Hayward 2011	1.416	Pyron 2013		
Halichoeres_radiatus	-0.770	Hayward 2011	2.117	Liao 2018		
Haliichthys_taeniophorus	-1.460	Kvarnemo 2004	1.013	Kvarnemo 2004		
Hesperoleucus_symmetricus	-1.620	Pyron 2013	0.176	Kvarnemo 2004	PA/PGA	Pyron 2013
Hippocampus_erectus	-2.102	Kvarnemo 2004	1.127	Liao 2018		

Ictalurus_punctatus	1.897	Stockley 1997	4.420	Kvarnemo 2004		M	Stockley 1997
Labeo_rohita	1.525	Liao 2018	3.255	Hayward 2011			
Lavinia_exilicauda	-0.932	Pyron 2013	0.726	Hayward 2011		PA/PGA	Pyron 2013
Lepidomeda_vittata	-1.222	Pyron 2013	0.125	Hayward 2011		PA/PGA	Pyron 2013
Lepomis_macrochirus	0.260	Liao 2018	1.754	Hayward 2011		PA/PGA	Stockley 1997; Liao 2018
Microphis_brachyurus	-2.650	Kvarnemo 2004	0.217	Hayward 2011			
Morone_chrysops	0.944	Liao 2018	2.387	Hayward 2011		PA/PGA	Liao 2018
Nerophis_ophidion	-2.848	Kvarnemo 2004	-0.444	Kvarnemo 2004		PA/PGA	Fishbase
Nocomis_asper	-0.636	Pyron 2013	1.519	Pyron 2013		M	Pyron 2013
Nocomis_biguttatus	-0.496	Pyron 2013	1.504	Kvarnemo 2004		PA/PGA	Fishbase
Nocomis_leptocephalus	-0.094	Pyron 2013	1.952	FishBase		M	Pyron 2013
Nocomis_micropogon	-1.886	Pyron 2013	0.637	Liao 2018		M	Pyron 2013
Notemigonus_crysoleucas	-1.222	Pyron 2013	0.416	Pyron 2013		PA/PGA	Pyron 2013
Oncorhynchus_kisutch	2.513	Liao 2018	3.588	Pyron 2013		PA/PGA	Stockley 1997; Liao 2018
Oncorhynchus_mykiss	1.788	Liao 2018	2.879	Liao 2018		PA/PGA	Stockley 1997; Liao 2018
Oncorhynchus_tshawytscha	1.695	Liao 2018	2.794	Kvarnemo 2004		PA/PGA	Stockley 1997; Liao 2018

Perca_fluviatilis	0.771	Liao 2018	1.982	Liao 2018		PA/PGA	Fishbase; Stockley 1997; Liao 2018
Phyllopteryx_taeniolatus	-1.500	Kvarnemo 2004	1.158	Kvarnemo 2004			
Pimephales_promelas	-1.538	Pyron 2013	0.462	Pyron 2013		PA/PGA	Fishbase
Polyodon_spathula	2.305	Liao 2018	4.175	Pyron 2013		PA/PGA	Stockley 1997; Liao 2018
Pseudocrenilabrus_multicolor	-1.523	Liao 2018	0.851	Pyron 2013		M	Liao 2018
Richardsonius_balteatus	-1.167	Pyron 2013	0.686	Pyron 2013		PA/PGA	Pyron 2013
Rutilus_rutilus	0.398	Liao 2018	1.792	Pyron 2013		PA/PGA	Liao 2018
Salmo_salar	2.420	Liao 2018	3.886	Liao 2018		PA/PGA	Stockley 1997; Liao 2018
Salmo_trutta	1.342	Liao 2018	2.602	Liao 2018		PA/PGA	Stockley 1997; Liao 2018
Sarotherodon_aff._galilaeus_mudfeeder	1.510	Stockley 1997	3.209	Liao 2018		M	Stockley 1997
Scardinius_erythrophthalmus	-0.125	Liao 2018	1.021	Liao 2018		PA/PGA	Stockley 1997; Liao 2018
Scarus_iseri	-1.097	Hayward 2011	1.727	Kvarnemo 2004		PG	Fishbase
Scarus_taeniopterus	-0.699	Hayward 2011	2.602	Pyron 2013		M	Fishbase
Scarus_vetula	-0.004	Hayward 2011	2.954	Liao 2018		PG	Fishbase
Solegnathus_guentheri	-1.810	Kvarnemo 2004	1.431	Liao 2018			

Sparisoma_atomarium	-1.699	Hayward 2011	1.000	Pyron 2013		PG	Fishbase
Sparisoma_aurofrenatum	-0.854	Hayward 2011	2.105	Liao 2018		PG	Fishbase
Sparisoma_chrysopterum	-0.620	Hayward 2011	2.535	Liao 2018		PG	Fishbase
Sparisoma_radians	-0.921	Hayward 2011	1.198	Liao 2018			
Sparisoma_rubripinne	-0.237	Hayward 2011	2.684	FishBase		PG	Fishbase
Sparisoma_viride	-0.602	Hayward 2011	2.620	Liao 2018		PG	Fishbase
Stigmatopora_argus	-2.474	Kvarnemo 2004	0.246	Hayward 2011			
Stigmatopora_nigra	-3.469	Kvarnemo 2004	-0.886	Hayward 2011			
Syngnathus_abaster	-2.932	Kvarnemo 2004	-0.337	Hayward 2011			
Syngnathus_acus	-1.281	Kvarnemo 2004	1.332	Kvarnemo 2004			
Syngnathus_floridae	-2.991	Kvarnemo 2004	-0.149	Hayward 2011			
Syngnathus_fuscus	-2.331	Kvarnemo 2004	0.196	Hayward 2011			
Syngnathus_rostellatus	-2.137	Kvarnemo 2004	-0.328	Hayward 2011			
Syngnathus_scovelli	-3.119	Kvarnemo 2004	-0.215	Hayward 2011		PA/PGA	Fishbase
Syngnathus_typhle	-2.476	Kvarnemo 2004	0.428	Hayward 2011		M	Stockley 1997
Thalassoma_bifasciatum	-1.523	Hayward 2011	1.135	Hayward 2011			
Tinca_tinca	0.489	Liao 2018	2.662	Kvarnemo 2004		PA/PGA	Stockley 1997; Liao 2018

Vanacampus_poecilolaemus	-2.307	Kvarnemo 2004	0.517	Kvarnemo 2004		PA/PGA	Fishbase
Frogs							
Physalaemus_cuvieri	-2.796	Prado 2003	0.000	Kvarnemo 2004	Original data is for Physalaemus_crombiei - taxa included by genus matching.	M/PG	Prado 2003
Kaloula_conjuncta	-1.896	Zheng 2014	0.740	Kvarnemo 2004	Original data is for Kaloula_verrucosa - taxa included by genus matching.	M/PG	Zeng 2014
Brachytarsophrys_feae	0.020	Zheng 2014	2.004	Kvarnemo 2004	Original data is for Brachytarsophrys_chuannanensis - taxa included by genus matching.	PA/PGA	Zeng 2014
Babina_chapaensis	-1.886	Liao 2018	0.964	Kvarnemo 2004	Original data is for Babina_daunchina - taxa included by genus matching.	M/PG	Liao 2018
Megophrys_nasuta	-1.524	Liao 2018	1.863	Kvarnemo 2004	Original data is for Megophrys_shapingensis - taxa included by genus matching.	M/PG	Zeng 2014
Adelotus_brevis	-2.208	Byrne 2002	0.734	Kvarnemo 2004		M/PG	Byrne 2002
Amietophrynus_garmani	-1.256	Prado 2003	1.630	Kvarnemo 2004		M/PG	Prado 2003
Amietophrynus_gutturalis	-0.926	Prado 2003	1.588	Hayward 2011		M/PG	Prado 2003
Amietophrynus_maculatus	-1.428	Prado 2003	0.991	Liao 2018		M/PG	Prado 2003
Amolops_lifanensis	-1.349	Zheng 2014	1.157	Kvarnemo 2004		M/PG	Zeng 2014
Amolops_mantzorum	-1.646	Zheng 2014	1.240	Zheng 2014		M/PG	Zeng 2014
Assa_darlingtoni	-3.097	Byrne 2002	-0.412	Byrne 2002		M/PG	Byrne 2002

Babina_pleuraden	-1.588	Zheng 2014	0.982	Zheng 2014	M/PG	Zeng 2014
Buergeria_buergeri	-1.674	Prado 2003	0.613	Prado 2003	M/PG	Prado 2003
Buergeria_japonica	-2.367	Prado 2003	0.255	Prado 2003	M/PG	Prado 2003
Bufo_gargarizans	-1.461	Zheng 2014	1.539	Zheng 2014	M/PG	Zeng 2014
Bufo_japonicus	-0.479	Prado 2003	1.974	Prado 2003	M/PG	Prado 2003
Bufo_tibetanus	-1.020	Zheng 2014	1.307	Zheng 2014	M/PG	Zeng 2014
Bufo_torrenticola	-0.514	Kusano 1991	1.990	Kusano 1991	M/PG	Kusano 1991
Chiromantis_xerampelina	0.013	Prado 2003	1.127	Prado 2003	PA/PGA	Prado 2003
Crinia_deserticola	-3.155	Byrne 2002	-0.665	Byrne 2002	M/PG	Byrne 2002
Crinia_parinsignifera	-4.000	Byrne 2002	-0.178	Byrne 2002	M/PG	Byrne 2002
Crinia_riparia	-3.155	Byrne 2002	-0.339	Byrne 2002	M/PG	Byrne 2002
Crinia_signifera	-3.699	Byrne 2002	-0.443	Byrne 2002	M/PG	Byrne 2002
Crinia_tinnula	-3.523	Byrne 2002	-0.509	Byrne 2002	M/PG	Byrne 2002
Cyclorana_alboguttata	-2.102	Byrne 2002	1.054	Byrne 2002	M/PG	Byrne 2002
Cyclorana_australis	-1.067	Byrne 2002	1.405	Byrne 2002	M/PG	Byrne 2002
Cyclorana_brevipes	-1.395	Byrne 2002	0.849	Byrne 2002		
Cyclorana_cryptotis	-2.222	Byrne 2002	0.717	Byrne 2002	M/PG	Byrne 2002

Cyclorana_cultripes	-2.149	Byrne 2002	0.708	Byrne 2002	M/PG	Byrne 2002
Cyclorana_longipes	-1.023	Byrne 2002	0.607	Byrne 2002	M/PG	Byrne 2002
Cyclorana_maculosa	-1.445	Byrne 2002	0.856	Byrne 2002		
Cyclorana_maini	-2.523	Byrne 2002	0.630	Byrne 2002	M/PG	Byrne 2002
Cyclorana_manya	-3.097	Byrne 2002	0.211	Byrne 2002	M/PG	Byrne 2002
Cyclorana_novaehollandiae	-1.256	Byrne 2002	1.516	Byrne 2002	M/PG	Byrne 2002
Cyclorana_platycephala	-1.742	Byrne 2002	1.055	Byrne 2002	M/PG	Byrne 2002
Cyclorana_vagitus	-1.903	Byrne 2002	0.875	Byrne 2002		
Cyclorana_verrucosa	-2.357	Byrne 2002	0.940	Byrne 2002	M/PG	Byrne 2002
Duttaphrynus_melanostictus	-1.676	Liao 2018	1.309	Liao 2018	M/PG	Zeng 2014
Eupemphix_nattereri	-1.770	Prado 2003	0.944	Prado 2003	M/PG	Prado 2003
Geocrinia_victoriana	-1.886	Byrne 2002	0.197	Byrne 2002	M/PG	Byrne 2002
Glandirana_rugosa	-1.834	Kusano 1991	0.828	Kusano 1991	M/PG	Kusano 1991
Heleioporus_australiacus	-1.126	Byrne 2002	1.753	Byrne 2002	M/PG	Byrne 2002
Hyla_annectans	-1.309	Zheng 2014	0.544	Zheng 2014	PA/PGA	Zeng 2014
Hyla_japonica	-2.167	Prado 2003	0.398	Prado 2003	M/PG	Prado 2003
Hyla_tsinlingensis	-2.076	Liao 2018	0.364	Liao 2018	M/PG	Zeng 2014

Hylarana_guentheri	-1.409	Zheng 2014	1.348	Zheng 2014		M/PG	Zeng 2014
Lechriodus_fletcheri	-2.046	Byrne 2002	0.891	Byrne 2002		M/PG	Byrne 2002
Leptodactylus_chaquensis	0.133	Prado 2003	1.516	Prado 2003		PA/PGA	Prado 2003
Leptodactylus_fuscus	-2.301	Prado 2003	0.886	Prado 2003		M/PG	Prado 2003
Leptodactylus_labyrinthicus	-0.658	Prado 2003	2.749	Prado 2003		M/PG	Prado 2003
Leptodactylus_mystacinus	-2.027	Prado 2003	1.185	Prado 2003		M/PG	Prado 2003
Leptodactylus_notoaktites	-2.301	Prado 2003	1.029	Prado 2003		M/PG	Prado 2003
Leptodactylus_ocellatus	-0.886	Prado 2003	2.055	Prado 2003		M/PG	Prado 2003
Leptodactylus_podicipinus	-1.481	Prado 2003	0.633	Prado 2003		PA/PGA	Prado 2003
Limnodynastes_convexiusculus	-1.670	Byrne 2002	0.998	Byrne 2002		M/PG	Byrne 2002
Limnodynastes_dorsalis	-1.583	Byrne 2002	1.278	Byrne 2002		M/PG	Byrne 2002
Limnodynastes_dumerilii	-1.883	Byrne 2002	1.185	Byrne 2002		M/PG	Byrne 2002
Limnodynastes_fletcheri	-2.137	Byrne 2002	1.055	Byrne 2002		M/PG	Byrne 2002
Limnodynastes_interioris	-1.407	Byrne 2002	1.562	Byrne 2002		M/PG	Byrne 2002
Limnodynastes_ornatus	-2.469	Byrne 2002	0.739	Byrne 2002		M/PG	Byrne 2002
Limnodynastes_peronii	-2.174	Byrne 2002	1.085	Byrne 2002		M/PG	Byrne 2002
Limnodynastes_salmini	-1.646	Byrne 2002	1.319	Byrne 2002		M/PG	Byrne 2002

Limnodynastes_spenceri	-3.222	Byrne 2002	0.617	Byrne 2002			M/PG	Byrne 2002
Limnodynastes_tasmaniensis	-2.538	Byrne 2002	0.528	Byrne 2002			M/PG	Byrne 2002
Limnodynastes_terraereginae	-2.114	Byrne 2002	1.344	Byrne 2002			M/PG	Byrne 2002
Litoria_adelaidensis	-2.469	Byrne 2002	0.488	Byrne 2002			M/PG	Byrne 2002
Litoria_aurea	-0.990	Byrne 2002	1.097	Byrne 2002			PA/PGA	Byrne 2002
Litoria_bicolor	-2.921	Byrne 2002	-0.203	Byrne 2002			M/PG	Byrne 2002
Litoria_brevipalmata	-2.284	Byrne 2002	0.532	Byrne 2002			M/PG	Byrne 2002
Litoria_caerulea	-1.717	Byrne 2002	1.416	Byrne 2002			M/PG	Byrne 2002
Litoria_cavernicola	-2.229	Byrne 2002	0.728	Byrne 2002			M/PG	Byrne 2002
Litoria_chloris	-1.660	Byrne 2002	1.101	Byrne 2002			M/PG	Byrne 2002
Litoria_citropa	-1.921	Byrne 2002	0.935	Byrne 2002			M/PG	Byrne 2002
Litoria_coplandi	-3.523	Byrne 2002	0.127	Byrne 2002			M/PG	Byrne 2002
Litoria_cyclorhyncha	-1.139	Byrne 2002	1.244	Byrne 2002			M/PG	Byrne 2002
Litoria_dahlii	-2.081	Byrne 2002	0.910	Byrne 2002			M/PG	Byrne 2002
Litoria_dentata	-1.951	Byrne 2002	0.547	Byrne 2002			M/PG	Byrne 2002
Litoria_electrica	-2.260	Byrne 2002	0.226	Byrne 2002			M/PG	Byrne 2002
Litoria_eucnemis	-2.244	Byrne 2002	0.575	Byrne 2002			M/PG	Byrne 2002

Litoria_ewingii	-2.824	Byrne 2002	0.229	Byrne 2002	M/PG	Byrne 2002
Litoria_fallax	-3.000	Byrne 2002	-0.028	Byrne 2002	M/PG	Byrne 2002
Litoria_freycineti	-2.276	Byrne 2002	0.508	Byrne 2002	M/PG	Byrne 2002
Litoria_genimaculata	-2.046	Byrne 2002	0.602	Byrne 2002	M/PG	Byrne 2002
Litoria_gracilenta	-2.620	Byrne 2002	0.404	Byrne 2002	M/PG	Byrne 2002
Litoria_inermis	-2.678	Byrne 2002	0.276	Byrne 2002	M/PG	Byrne 2002
Litoria_infrafrenata	-1.391	Byrne 2002	1.388	Byrne 2002	M/PG	Byrne 2002
Litoria_latopalmata	-2.678	Byrne 2002	0.291	Byrne 2002	M/PG	Byrne 2002
Litoria_lesueurii	-1.701	Byrne 2002	0.732	Byrne 2002	M/PG	Byrne 2002
Litoria_littlejohni	-1.914	Byrne 2002	0.824	Byrne 2002	M/PG	Byrne 2002
Litoria_meiriana	-4.000	Byrne 2002	-0.276	Byrne 2002	M/PG	Byrne 2002
Litoria_moorei	-1.005	Byrne 2002	1.082	Byrne 2002	PA/PGA	Byrne 2002
Litoria_nannotis	-1.506	Byrne 2002	0.968	Byrne 2002	M/PG	Byrne 2002
Litoria_nasuta	-2.357	Byrne 2002	0.625	Byrne 2002	M/PG	Byrne 2002
Litoria_nigrofrenata	-2.194	Byrne 2002	0.367	Byrne 2002	M/PG	Byrne 2002
Litoria_nyakalensis	-2.745	Byrne 2002	0.400	Byrne 2002	M/PG	Byrne 2002
Litoria_olongburensis	-2.143	Byrne 2002	-0.241	Byrne 2002		

Litoria_pallida	-2.854	Byrne 2002	0.235	Byrne 2002			M/PG	Byrne 2002
Litoria_paraewingi	-3.000	Byrne 2002	0.081	Byrne 2002			M/PG	Byrne 2002
Litoria_pearsoniana	-2.959	Byrne 2002	0.037	Byrne 2002			M/PG	Byrne 2002
Litoria_peronii	-1.963	Byrne 2002	0.769	Byrne 2002			M/PG	Byrne 2002
Litoria_phyllochroa	-2.824	Byrne 2002	0.065	Byrne 2002			PA/PGA	Byrne 2002
Litoria_raniformis	-1.262	Byrne 2002	1.185	Byrne 2002			PA/PGA	Byrne 2002
Litoria_revelata	-3.000	Byrne 2002	-0.031	Byrne 2002				
Litoria_rheocola	-2.469	Byrne 2002	0.218	Byrne 2002			M/PG	Byrne 2002
Litoria_rothii	-2.167	Byrne 2002	0.722	Byrne 2002			M/PG	Byrne 2002
Litoria_rubella	-2.143	Byrne 2002	0.489	Byrne 2002			M/PG	Byrne 2002
Litoria_splendida	-1.072	Byrne 2002	1.568	Byrne 2002			M/PG	Byrne 2002
Litoria_subglandulosa	-1.967	Byrne 2002	0.754	Byrne 2002			M/PG	Byrne 2002
Litoria_tornieri	-3.097	Byrne 2002	0.137	Byrne 2002			M/PG	Byrne 2002
Litoria_tyleri	-1.764	Byrne 2002	0.754	Byrne 2002			M/PG	Byrne 2002
Litoria_verreauxii	-2.921	Byrne 2002	0.240	Byrne 2002			M/PG	Byrne 2002
Litoria_watjulumensis	-2.357	Byrne 2002	0.413	Byrne 2002			M/PG	Byrne 2002
Litoria_xanthomera	-2.041	Byrne 2002	0.768	Byrne 2002			M/PG	Byrne 2002

Mixophyes_balbus	-1.648	Byrne 2002	1.101	Byrne 2002	M/PG	Byrne 2002
Mixophyes_fasciolatus	-1.481	Byrne 2002	1.307	Byrne 2002	M/PG	Byrne 2002
Mixophyes_schevilli	-1.439	Byrne 2002	1.503	Byrne 2002	M/PG	Byrne 2002
Myobatrachus_gouldii	-2.420	Byrne 2002	0.563	Byrne 2002	M/PG	Byrne 2002
Nanorana_parkeri	-1.428	Liao 2018	1.244	Liao 2018	M/PG	Zeng 2014
Nanorana_pleskei	-1.428	Zheng 2014	1.244	Zheng 2014	M/PG	Zeng 2014
Nanorana_quadranus	0.192	Zheng 2014	1.637	Zheng 2014	PA/PGA	Zeng 2014
Nanorana_ventripunctata	-1.740	Zheng 2014	0.629	Zheng 2014	M/PG	Zeng 2014
Nanorana_yunnanensis	-0.388	Zheng 2014	1.477	Zheng 2014	M/PG	Zeng 2014
Neobatrachus_pelobatoides	-1.160	Byrne 2002	0.785	Byrne 2002	PA/PGA	Byrne 2002
Neobatrachus_pictus	-0.818	Byrne 2002	1.091	Byrne 2002	M/PG	Byrne 2002
Neobatrachus_sudelli	-1.236	Byrne 2002	0.885	Byrne 2002	M/PG	Byrne 2002
Notaden_bennettii	-2.009	Byrne 2002	1.238	Byrne 2002	M/PG	Byrne 2002
Notaden_melanoscaphus	-1.762	Byrne 2002	0.950	Byrne 2002	M/PG	Byrne 2002
Nyctimystes_dayi	-2.770	Byrne 2002	0.368	Byrne 2002	M/PG	Byrne 2002
Nyctimystes_papua	-2.770	Hayward 2011	0.368	Hayward 2011		
Odorrana_grahami	-1.320	Zheng 2014	1.360	Zheng 2014	M/PG	Zeng 2014

Odorrana_margaretae	-1.188	Zheng 2014	1.521	Zheng 2014	M/PG	Zeng 2014
Paracrinia_haswelli	-2.824	Byrne 2002	0.290	Byrne 2002	M/PG	Byrne 2002
Pelophylax_hubeiensis	-2.495	Liao 2018	0.708	Liao 2018	M/PG	Zeng 2014
Pelophylax_nigromaculatus	-1.618	Zheng 2014	1.343	Zheng 2014	M/PG	Zeng 2014
Pelophylax_porosus	-1.606	Prado 2003	1.173	Prado 2003	M/PG	Prado 2003
Philoria_sphagnicolus	-1.959	Byrne 2002	0.326	Byrne 2002	M/PG	Byrne 2002
Phyllomedusa_hypochondrialis	-1.921	Prado 2003	0.431	Prado 2003	M/PG	Prado 2003
Physalaemus_albonotatus	-2.854	Prado 2003	0.079	Prado 2003	M/PG	Prado 2003
Polypedates_leucomystax	-1.304	Prado 2003	0.857	Prado 2003	PA/PGA	Prado 2003
Polypedates_megacephalus	-0.995	Zheng 2014	0.916	Zheng 2014	PA/PGA	Zeng 2014
Polypedates_mutus	-1.383	Liao 2018	0.692	Liao 2018	PA/PGA	Zeng 2014
Pseudophryne_bibroni	-1.947	Byrne 2002	0.077	Byrne 2002	M/PG	Byrne 2002
Pseudophryne_coriacea	-2.824	Byrne 2002	0.054	Byrne 2002	M/PG	Byrne 2002
Quasipaa_boulengeri	-0.348	Zheng 2014	1.722	Zheng 2014	M/PG	Zeng 2014
Rana_catesbeiana	-1.000	Hayward 2011	2.494	Hayward 2011	M/PG	Ryan 1980
Rana_chaochiaoensis	-1.860	Zheng 2014	0.913	Zheng 2014	M/PG	Zeng 2014
Rana_chensinensis	-1.607	Zheng 2014	0.997	Zheng 2014	M/PG	Zeng 2014

Rana_japonica	-1.836	Liao 2018	1.476	Liao 2018	M/PG	Zeng 2014
Rana_kukunoris	-1.096	Liao 2011	0.994	Liao 2011	M/PG	Liao 2011
Rana_omeimontis	-2.796	Zheng 2014	1.074	Zheng 2014	M/PG	Zeng 2014
Rana_ornativentris	-1.444	Prado 2003	1.140	Prado 2003	M/PG	Prado 2003
Rana_tagoi	-1.635	Prado 2003	0.771	Prado 2003	M/PG	Prado 2003
Rana_tsushimensis	-2.202	Kusano 1991	0.509	Kusano 1991	M/PG	Kusano 1991
Rhacophorus_arboreus	-0.123	Prado 2003	1.143	Prado 2003	PA/PGA	Prado 2003
Rhacophorus_chenfui	-0.882	Zheng 2014	0.840	Zheng 2014	PA/PGA	Zeng 2014
Rhacophorus_dennysi	-1.014	Liao 2018	0.728	Liao 2018	PA/PGA	Zeng 2014
Rhacophorus_dugritei	-1.024	Zheng 2014	0.849	Zheng 2014	PA/PGA	Zeng 2014
Rhacophorus_omeimontis	-0.350	Zheng 2014	1.199	Zheng 2014	PA/PGA	Zeng 2014
Rhacophorus_schlegelii	-1.475	Prado 2003	0.505	Prado 2003	PA/PGA	Prado 2003
Rheobatrachus_silus	-2.027	Byrne 2002	0.777	Byrne 2002		
Rhinella_marina	-0.463	Kusano 1991	2.063	Kusano 1991	M/PG	Kusano 1991
Scinax_acuminatus	-2.076	Prado 2003	0.763	Prado 2003	M/PG	Prado 2003
Scinax_nasicus	-2.222	Prado 2003	0.255	Prado 2003	M/PG	Prado 2003
Taudactylus_acutirostris	-3.523	Byrne 2002	-0.059	Byrne 2002	M/PG	Byrne 2002

Tomopterna_cryptotis	-1.745	Jennions 1993	0.816	Jennions 1993			
Uperoleia_laevigata	-2.770	Byrne 2002	0.118	Byrne 2002		M/PG	Byrne 2002
Uperoleia_littlejohni	-2.456	Byrne 2002	0.041	Byrne 2002		M/PG	Byrne 2002
Fejervarya_limnocharis	-1.686	Zheng 2014	0.659	Zheng 2014		M/PG	Zeng 2014
Ptychadena_anchietae	-1.818	Prado 2003	0.748	Prado 2003		M/PG	Prado 2003
Ptychadena_oxyrhynchus	-1.504	Jennions 1993	1.172	Jennions 1993			
Ptychadena_porosissima	-2.022	Jennions 1993	0.740	Jennions 1993			
Ptychadena_mascareniensis	-1.547	Jennions 1993	1.017	Jennions 1993			
Phrynobatrachus_natalensis	-2.553	Jennions 1993	0.412	Jennions 1993			
Microhyla_ornata	-2.959	Zheng 2014	-0.143	Zheng 2014		M/PG	Zeng 2014
Hyperolius_tuberilinguis	-2.292	Jennions 1993	0.149	Jennions 1993			
Hyperolius_marmoratus	-2.538	Jennions 1993	0.130	Jennions 1993		M/PG	Telford 1988
Hyperolius_argus	-2.387	Jennions 1993	0.301	Jennions 1993			
Afrixalus_fornasini	-2.420	Jennions 1993	0.408	Jennions 1993			
Kassina_senegalensis	-1.493	Jennions 1993	0.699	Jennions 1993			
Kassina_maculata	-1.151	Jennions 1993	1.192	Jennions 1993			
Leptopelis_natalensis	-2.041	Prado 2003	0.672	Prado 2003		M/PG	Prado 2003

Hemisus_marmoratus	-2.409	Jennions 1993	0.500	Jennions 1993		M/PG	Kaminsky 1999
Xenophrys_omeimontis	-1.273	Liao 2018	0.652	Liao 2018		M/PG	Zeng 2014
Scaphiopus_couchii	-1.347	Hayward 2011	1.476	Hayward 2011		M/PG	Pfennig 2000; Klein 2000
Bombina_maxima	-0.779	Zheng 2014	1.278	Zheng 2014		M/PG	Zeng 2014
Birds							
Ailuroedus_melanotis	-0.161	Calhim 2006	2.173	Calhim 2006	Original data is for Ailuroedus_buccoides - taxa included by genus matching. All members of this genus are defined as monogamous in source.	M	Lenz 1994
Anhinga_anhinga	0.748	Calhim 2006	3.245	Calhim 2006	Original data is for Anhinga_melanogaster - taxa included by genus matching.		
Calandrella_acutirostris	0.013	Calhim 2006	1.322	Calhim 2006	Original data is for Calandrella_cinerea - taxa included by genus matching.		
Cinclus_cinclus	-1.097	Calhim 2006	1.653	Calhim 2006	Original data is for Cinclus_leucocephalus - taxa included by genus matching.	M	Biagolini 2017
Cotinga_cayana	-0.456	Calhim 2006	1.819	Calhim 2006	Original data is for Cotinga_amabilis - taxa included by genus matching.		
Cyphorhinus_arada	-1.222	Hayward 2011	1.391	Hayward 2011	Original data is for Cyphorhinus_phaeocephalus - taxa included by genus matching.		
Ducula_aenea	0.344	Calhim 2006	2.669	Calhim 2006	Original data is for Ducula_spilorrhoa - taxa included by genus matching.		

Grallaria_andicolus	0.004	Calhim 2006	1.822	Calhim 2006	Original data is for Grallaria_quitensis - taxa included by genus matching.		
Hylopezus_berlepschi	-1.398	Calhim 2006	1.623	Calhim 2006	Original data is for Hylopezus_perspicillatus - taxa included by genus matching.		
Laniocera_hypopyrra	-1.222	Calhim 2006	1.690	Calhim 2006	Original data is for Laniocera_rufescens - taxa included by genus matching.		
Oncostoma_cinereigulare	-1.699	Calhim 2006	0.903	Calhim 2006	Original data is for Oncostoma_olivaceum - taxa included by genus matching.		
Sphecotheres_vieilloti	0.104	Calhim 2006	2.140	Calhim 2006	Original data is for Sphecotheres_viridis - taxa included by genus matching.		
Acanthagenys_rufogularis	-0.347	Hayward 2011	1.699	Hayward 2011		M	Garamszegi 2005; Pitcher 2005
Acanthiza_apicalis	-1.097	Calhim 2006	0.845	Calhim 2006		M	Pitcher 2005
Acanthiza_chrysorrhoa	-1.097	Calhim 2006	0.903	Calhim 2006		C	Pitcher 2005
Acanthiza_lineata	-0.854	Calhim 2006	0.857	Calhim 2006		C	Pitcher 2005
Acanthiza_nana	-0.367	Calhim 2006	0.845	Calhim 2006		C	Pitcher 2005
Acanthiza_pusilla	-0.959	Calhim 2006	0.881	Calhim 2006		M	Pitcher 2005
Acanthiza_reguloides	-1.000	Calhim 2006	0.881	Calhim 2006		M	Pitcher 2005
Acanthiza_uropygialis	-1.523	Calhim 2006	0.857	Calhim 2006		C	Pitcher 2005
Acanthorhynchus_tenuirostris	-0.921	Calhim 2006	1.086	Calhim 2006		M	Pitcher 2005
Accipiter_cirrocephalus	-0.921	Calhim 2006	2.111	Calhim 2006		M	Pitcher 2005

Accipiter_gentilis	0.863	Calhim 2006	2.935	Calhim 2006		M	Pitcher 2005
Accipiter_nisus	-0.276	Calhim 2006	2.146	Calhim 2006		M	Pitcher 2005
Accipiter_novaehollandiae	-0.699	Calhim 2006	2.549	Calhim 2006		M	Pitcher 2005
Sturnus_tristis	-0.456	Calhim 2006	2.137	Calhim 2006		M	Pitcher 2005
Acrocephalus_arundinaceus	-0.337	Calhim 2006	1.435	Calhim 2006		PG	Pitcher 2005; Biagolini 2017
Acrocephalus_melanopogon	-0.569	Calhim 2006	1.041	Calhim 2006		M	Biagolini 2017
Acrocephalus_paludicola	-0.432	Calhim 2006	1.064	Calhim 2006		PG	Pitcher 2005
Acrocephalus_palustris	-0.854	Calhim 2006	1.079	Calhim 2006		PG	Pitcher 2005; Biagolini 2017
Acrocephalus_schoenobaenus	-0.770	Calhim 2006	1.083	Calhim 2006		PG	Pitcher 2005; Biagolini 2017
Acrocephalus_scirpaceus	-0.824	Hayward 2011	1.079	Hayward 2011		PG	Garamszegi 2005; Pitcher 2005; Biagolini 2017
Acrocephalus_stentoreus	-1.523	Calhim 2006	1.204	Calhim 2006		PG	Pitcher 2005
Actitis_macularia	-0.252	Hayward 2011	1.605	Hayward 2011		PA/PGA	Garamszegi 2005; Griffith 2002; Pitcher

							2005; Biagolini 2017; Szekely 2000
Aegithalos_caudatus	-1.523	Calhim 2006	0.914	Calhim 2006		C	Biagolini 2017
Aegolius_funereus	0.107	Calhim 2006	2.000	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Aethia_pusilla	0.407	Calhim 2006	1.991	Calhim 2006		M	Pitcher 2005
Agelaius_phoeniceus	-0.268	Hayward 2011	1.803	Hayward 2011		PG	Pitcher 2005; Biagolini 2017
Agelaius_tricolor	0.053	Calhim 2006	1.826	Calhim 2006		PG	Pitcher 2005
Ailuroedus_crassirostris	-0.444	Calhim 2006	2.179	Calhim 2006	All members of this genus are defined as monogamous in source.	M	Pitcher 2005; Lenz 1994
Aimophila_aestivalis	-0.921	Calhim 2006	1.260	Calhim 2006			
Peucaea_botterii	-0.509	Calhim 2006	1.294	Calhim 2006		M	Pitcher 2005
Aimophila_cassinii	-0.678	Calhim 2006	1.255	Calhim 2006		M	Pitcher 2005
Aimophila_ruficeps	-0.509	Calhim 2006	1.292	Calhim 2006		M	Pitcher 2005
Aix_sponsa	-0.009	Calhim 2006	2.833	Calhim 2006		M	Garamszegi 2005; Pitcher 2005
Alauda_arvensis	-0.357	Calhim 2006	1.591	Calhim 2006		M	Pitcher 2005;

							Biagolini 2017
Alca_torda	0.568	Calhim 2006	2.857	Calhim 2006		M	Pitcher 2005
Aleadryas_rufinucha	-0.387	Calhim 2006	1.568	Calhim 2006		M	Pitcher 2005
Alectoris_chukar	0.450	Calhim 2006	2.712	Calhim 2006			
Alectoris_graeca	0.447	Calhim 2006	2.653	Calhim 2006		M	Pitcher 2005
Alectoris_rufa	0.860	Calhim 2006	2.653	Calhim 2006		M	Pitcher 2005
Alectura_lathami	0.243	Calhim 2006	3.389	Calhim 2006		PA/PGA	Pitcher 2005; Biagolini 2017
Alisterus_scapularis	-0.959	Calhim 2006	2.324	Calhim 2006		M	Pitcher 2005
Alle_alle	0.405	Calhim 2006	2.146	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Amalocichla_incerta	-0.678	Calhim 2006	1.423	Calhim 2006		M	Pitcher 2005
Amandava_amandava	-1.097	Calhim 2006	0.903	Calhim 2006		PG	Pitcher 2005
Amblyornis_macgregoriae	-0.268	Calhim 2006	2.104	Calhim 2006	Lekking	PG	Pitcher 2005; Diamond 1986; Pruett-Jones 1982; Lenz 1994
Ammodramus_bairdii	-0.481	Calhim 2006	1.276	Calhim 2006		M	Pitcher 2005

Ammodramus_caudacutus	0.100	Calhim 2006	1.241	Calhim 2006		PG	Pitcher 2005
Ammodramus_leconteii	-0.301	Calhim 2006	1.130	Calhim 2006		M	Pitcher 2005
Ammodramus_maritimus	-0.481	Calhim 2006	1.352	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Ammodramus_nelsoni	-0.886	Calhim 2006	1.220	Calhim 2006			
Ammodramus_savannarum	-0.409	Calhim 2006	1.248	Calhim 2006		M	Pitcher 2005
Ammomanes_grayi	-0.796	Calhim 2006	1.301	Calhim 2006		M	Pitcher 2005
Amphispiza_bilineata	-0.602	Hayward 2011	1.130	Hayward 2011		M	Garamszegi 2005; Pitcher 2005
Amytornis_purnelli	-1.222	Calhim 2006	1.342	Calhim 2006		C	Pitcher 2005
Amytornis_striatus	-0.398	Calhim 2006	1.279	Calhim 2006		M	Pitcher 2005
Anas_acuta	0.977	Calhim 2006	2.954	Calhim 2006		M	Pitcher 2005
Anas_americana	0.949	Calhim 2006	2.899	Calhim 2006		M	Pitcher 2005
Anas_castanea	0.356	Calhim 2006	2.819	Calhim 2006		M	Pitcher 2005
Anas_clypeata	0.360	Calhim 2006	2.785	Calhim 2006		M	Pitcher 2005
Anas_crecca	0.593	Calhim 2006	2.556	Calhim 2006		M	Pitcher 2005
Anas_discors	0.225	Calhim 2006	2.591	Calhim 2006		M	Pitcher 2005
Anas_georgica	0.991	Calhim 2006	2.800	Calhim 2006		M	Pitcher 2005

Anas_gracilis	-0.155	Calhim 2006	2.690	Calhim 2006			M	Pitcher 2005
Anas_platyrhynchos	0.982	Hayward 2011	3.057	Hayward 2011			M	Garamszegi 2005; Pitcher 2005; Biagolini 2017
Anas_rhynchotis	-0.347	Calhim 2006	2.824	Calhim 2006			M	Pitcher 2005
Anas_rubripes	-0.244	Calhim 2006	3.146	Calhim 2006			M	Pitcher 2005
Anas_superciliosa	0.778	Calhim 2006	3.000	Calhim 2006			M	Pitcher 2005
Anisognathus_igniventris	-0.432	Calhim 2006	1.531	Calhim 2006			M	Pitcher 2005
Anous_stolidus	-0.409	Calhim 2006	2.083	Calhim 2006			M	Pitcher 2005
Anser_albifrons	-0.092	Calhim 2006	3.432	Calhim 2006			M	Pitcher 2005
Anser_anser	0.602	Calhim 2006	3.539	Calhim 2006			M	Pitcher 2005
Anthochaera_carunculata	-0.284	Calhim 2006	2.053	Calhim 2006			M	Pitcher 2005
Anthochaera_chrysoptera	-0.398	Calhim 2006	1.924	Calhim 2006			M	Pitcher 2005
Anthochaera_paradoxa	-1.301	Calhim 2006	2.253	Calhim 2006			M	Pitcher 2005
Anthus_campestris	-0.367	Calhim 2006	1.362	Calhim 2006				
Anthus_pratensis	-0.495	Calhim 2006	1.255	Calhim 2006			M	Pitcher 2005
Anthus_rubescens	-0.180	Calhim 2006	1.338	Calhim 2006			M	Pitcher 2005

Anthus_spinoletta	-0.372	Calhim 2006	1.377	Calhim 2006		PA/PGA	Pitcher 2005; Biagolini 2017
Aphelocoma_coerulescens	0.258	Hayward 2011	1.904	Hayward 2011		C	Griffith 2002; Pitcher 2005; Biagolini 2017
Aphelocoma_ultramarina	0.170	Calhim 2006	2.078	Calhim 2006		C	Griffith 2002; Pitcher 2005; Biagolini 2017
Aplonis_metallica	-0.244	Calhim 2006	1.806	Calhim 2006		M	Pitcher 2005
Aptenodytes_forsteri	1.602	Hayward 2011	4.531	Hayward 2011		M	Garamszegi 2005; Pitcher 2005
Apus_apus	0.053	Calhim 2006	1.613	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Aquila_chrysaetos	0.867	Calhim 2006	3.569	Calhim 2006		M	Pitcher 2005
Hieraaetus_fasciatus	0.362	Calhim 2006	3.223	Calhim 2006		M	Pitcher 2005
Aramus_guarauna	0.702	Calhim 2006	3.142	Calhim 2006		M	Pitcher 2005
Archilochus_colubris	-1.699	Calhim 2006	0.459	Calhim 2006		PG	Pitcher 2005
Ardea_herodias	0.176	Calhim 2006	3.411	Calhim 2006		M	Pitcher 2005

Arenaria_interpres	-0.699	Calhim 2006	2.041	Calhim 2006		M	Pitcher 2005; Szekely 2000
Buarremon_brunneinucha	-0.721	Calhim 2006	1.668	Calhim 2006		M	Pitcher 2005
Arremonops_rufivirgatus	-0.796	Calhim 2006	1.373	Calhim 2006		M	Pitcher 2005
Arses_telescopthalmus	-0.602	Calhim 2006	1.204	Calhim 2006		M	Pitcher 2005
Artamus_cinereus	-0.268	Calhim 2006	1.556	Calhim 2006		C	Pitcher 2005
Artamus_cyanopterus	-0.347	Calhim 2006	1.505	Calhim 2006		C	Pitcher 2005
Artamus_leucorhynchus	-1.155	Calhim 2006	1.591	Calhim 2006		C	Pitcher 2005
Artamus_minor	-0.770	Calhim 2006	1.255	Calhim 2006		C	Pitcher 2005
Asio_flammeus	0.583	Calhim 2006	2.550	Calhim 2006		M	Pitcher 2005
Asio_otus	0.433	Calhim 2006	2.436	Calhim 2006		M	Pitcher 2005
Astrapia_splendidissima	-0.495	Calhim 2006	2.079	Calhim 2006	Lekking	PG	Pitcher 2005; Hoglund 1989; Irestedt et al 2009
Astrapia_stephaniae	-0.092	Calhim 2006	2.358	Calhim 2006	Lekking	PG	Pitcher 2005; Hoglund 1989; Irestedt et al 2009
Atlapetes_albinucha	-0.620	Calhim 2006	1.510	Calhim 2006		M	Pitcher 2005

Atlapetes_pileatus	-0.721	Calhim 2006	1.380	Calhim 2006	M	Pitcher 2005
Attagis_gayi	-0.854	Calhim 2006	2.493	Calhim 2006	M	Pitcher 2005; Szekely 2000
Aulacorhynchus_prasinus	-0.620	Calhim 2006	2.255	Calhim 2006	M	Pitcher 2005
Auriparus_flaviceps	-1.409	Calhim 2006	0.814	Calhim 2006	M	Pitcher 2005
Aviceda_subcristata	-0.347	Calhim 2006	2.529	Calhim 2006	M	Pitcher 2005
Aythya_affinis	0.528	Calhim 2006	2.806	Calhim 2006	M	Pitcher 2005
Aythya_collaris	-0.959	Calhim 2006	2.877	Calhim 2006	M	Pitcher 2005
Aythya_marila	-0.959	Calhim 2006	2.969	Calhim 2006	M	Pitcher 2005
Aythya_valisineria	-0.721	Calhim 2006	3.096	Calhim 2006	M	Pitcher 2005
Baeolophus_bicolor	-0.770	Calhim 2006	1.318	Calhim 2006	M	Pitcher 2005
Baeolophus_inornatus	-1.301	Calhim 2006	1.272	Calhim 2006	M	Pitcher 2005
Baeolophus_wollweberi	-1.222	Calhim 2006	0.996	Calhim 2006	C	Pitcher 2005
Baryphthengus_martii	-1.000	Calhim 2006	2.202	Calhim 2006	M	Pitcher 2005
Basileuterus_belli	-0.745	Calhim 2006	1.021	Calhim 2006	M	Pitcher 2005
Basileuterus_bivittatus	-0.699	Calhim 2006	1.149	Calhim 2006	M	Pitcher 2005
Basileuterus_coronatus	-0.678	Calhim 2006	1.199	Calhim 2006	M	Pitcher 2005

Basileuterus_melanogenys	-0.824	Calhim 2006	1.130	Calhim 2006		M	Pitcher 2005
Basileuterus_rufifrons	-0.921	Calhim 2006	1.000	Calhim 2006		M	Pitcher 2005
Biziura_lobata	0.513	Calhim 2006	3.380	Calhim 2006			
Bombycilla_cedrorum	-1.000	Calhim 2006	1.500	Calhim 2006		M	Pitcher 2005
Bombycilla_garrulus	-0.444	Calhim 2006	1.695	Calhim 2006		M	Pitcher 2005
Tetrastes_bonasia	0.053	Calhim 2006	2.559	Calhim 2006			
Bonasa_umbellus	0.286	Calhim 2006	2.761	Calhim 2006	Lekking		Pitcher 2005
Branta_bernicla	-0.201	Hayward 2011	3.161	Hayward 2011		M	Pitcher 2005; Biagolini 2017
Branta_canadensis	0.629	Calhim 2006	3.589	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Branta_leucopsis	0.188	Calhim 2006	3.252	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Branta_sandvicensis	0.137	Calhim 2006	3.333	Calhim 2006		M	Pitcher 2005
Brotogeris_cyanoptera	-0.387	Calhim 2006	1.866	Calhim 2006		M	Pitcher 2005
Bubo_bubo	0.825	Calhim 2006	3.391	Calhim 2006		M	Pitcher 2005
Bubulcus_ibis	-0.569	Calhim 2006	2.562	Calhim 2006		M	Pitcher 2005
Bucephala_albeola	-0.523	Calhim 2006	2.675	Calhim 2006		M	Pitcher 2005

Burhinus_grallarius	-0.268	Calhim 2006	2.827	Calhim 2006		M	Pitcher 2005; Szekely 2000
Buteo_buteo	0.403	Calhim 2006	2.863	Calhim 2006		M	Pitcher 2005
Buteo_jamaicensis	0.124	Calhim 2006	2.978	Calhim 2006		M	Pitcher 2005
Buteo_lagopus	-0.569	Calhim 2006	2.928	Calhim 2006		M	Pitcher 2005
Buteo_magnirostris	-0.745	Calhim 2006	2.430	Calhim 2006		M	Pitcher 2005
Buteo_nitidus	-0.699	Calhim 2006	2.668	Calhim 2006		M	Pitcher 2005
Buteo_platypterus	-0.222	Calhim 2006	2.623	Calhim 2006		M	Pitcher 2005
Buthraupis_montana	-0.222	Calhim 2006	2.009	Calhim 2006		M	Pitcher 2005
Cacatua_galerita	-0.469	Calhim 2006	2.921	Calhim 2006		M	Pitcher 2005
Cacicus_cela	-0.149	Calhim 2006	2.020	Calhim 2006		PG	Pitcher 2005
Cairina_moschata	1.477	Calhim 2006	3.556	Calhim 2006		PG	Pitcher 2005
Calamanthus_campestris	-0.921	Calhim 2006	1.041	Calhim 2006		M	Pitcher 2005
Calamospiza_melanocorys	-0.060	Calhim 2006	1.602	Calhim 2006		PG	Pitcher 2005
Calcarius_lapponicus	-0.268	Hayward 2011	1.436	Hayward 2011		PG	Pitcher 2005
Calcarius_mccownii	-0.638	Calhim 2006	1.403	Calhim 2006		M	Pitcher 2005
Calcarius_ornatus	-0.569	Calhim 2006	1.297	Calhim 2006		M	Pitcher 2005

Calcarius_pictus	0.079	Calhim 2006	1.455	Calhim 2006		PA/PGA	Griffith 2002; Pitcher 2005; Biagolini 2017
Calidris_alba	-0.354	Calhim 2006	1.700	Calhim 2006		PA/PGA	Pitcher 2005; Szekely 2000
Calidris_alpina	-0.669	Calhim 2006	1.731	Calhim 2006		M	Pitcher 2005; Szekely 2000
Calidris_bairdii	-0.771	Calhim 2006	1.609	Calhim 2006		M	Pitcher 2005; Szekely 2000
Calidris_canutus	-0.141	Calhim 2006	2.094	Calhim 2006		M	Pitcher 2005; Szekely 2000
Calidris_fuscicollis	-0.602	Calhim 2006	1.617	Calhim 2006		PG	Pitcher 2005; Szekely 2000
Micropalama_himantopus	-0.620	Calhim 2006	1.716	Calhim 2006		M	Pitcher 2005; Szekely 2000
Calidris_maritima	-0.719	Calhim 2006	1.846	Calhim 2006		M	Pitcher 2005; Biagolini 2017; Szekely 2000

Calidris_mauri	-0.310	Hayward 2011	1.415	Hayward 2011			M	Garamszegi 2005; Pitcher 2005; Biagolini 2017; Szekely 2000
Calidris_melanotos	-0.125	Calhim 2006	1.993	Calhim 2006	Lekking		PG	Pitcher 2005; Holmes 1998; Szekely 2000
Calidris_minuta	-0.540	Calhim 2006	1.342	Calhim 2006			PA/PGA	Pitcher 2005
Calidris_minutilla	-1.421	Calhim 2006	1.362	Calhim 2006			M	Pitcher 2005; Szekely 2000
Calidris_ptilocnemis	-0.427	Calhim 2006	1.899	Calhim 2006			M	Pitcher 2005; Szekely 2000
Calidris_pusilla	-0.310	Hayward 2011	1.447	Hayward 2011			M	Garamszegi 2005; Pitcher 2005; Szekely 2000
Calidris_ruficollis	-0.890	Calhim 2006	1.519	Calhim 2006			M	Pitcher 2005; Szekely 2000
Calidris_temminckii	-0.499	Calhim 2006	1.415	Calhim 2006			PA/PGA	Pitcher 2005
Callipepla_californica	0.204	Calhim 2006	2.255	Calhim 2006			M	Pitcher 2005

Callipepla_gambelii	0.155	Calhim 2006	2.202	Calhim 2006		M	Pitcher 2005
Callipepla_squamata	0.152	Calhim 2006	2.256	Calhim 2006		M	Pitcher 2005
Callocephalon_fimbriatum	-0.959	Calhim 2006	2.433	Calhim 2006		M	Pitcher 2005
Calypte_anna	-2.000	Calhim 2006	0.699	Calhim 2006	Lekking	PG	Pitcher 2005; Emlen 1977
Calyptorhynchus_banksii	0.093	Calhim 2006	2.888	Calhim 2006		M	Pitcher 2005
Campylorhynchus_brunneicapillus	-1.046	Hayward 2011	1.590	Hayward 2011		M	Garamszegi 2005
Capito_niger	-0.638	Calhim 2006	1.845	Calhim 2006		M	Pitcher 2005
Cardinalis_cardinalis	-0.347	Calhim 2006	1.640	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Cardinalis_sinuatus	-0.745	Calhim 2006	1.567	Calhim 2006		M	Pitcher 2005
Carduelis_cannabina	-0.699	Calhim 2006	1.279	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Carduelis_carduelis	-0.873	Calhim 2006	1.204	Calhim 2006		M	Pitcher 2005
Carduelis_chloris	-0.688	Calhim 2006	1.436	Calhim 2006		M	Pitcher 2005
Carduelis_flammea	-0.409	Hayward 2011	1.079	Hayward 2011		M	Garamszegi 2005; Pitcher 2005
Carduelis_hornemanni	-0.745	Calhim 2006	1.146	Calhim 2006		M	Pitcher 2005

Carduelis_pinus	-0.854	Calhim 2006	1.111	Calhim 2006	M	Pitcher 2005
Carduelis_psaltria	-1.000	Calhim 2006	0.996	Calhim 2006	M	Pitcher 2005
Carduelis_tristis	-0.638	Calhim 2006	1.107	Calhim 2006	M	Pitcher 2005; Biagolini 2017
Carpodacus_cassinii	-1.155	Calhim 2006	1.430	Calhim 2006	M	Pitcher 2005
Carpodacus_erythrinus	-0.620	Calhim 2006	1.342	Calhim 2006	PG	Pitcher 2005; Biagolini 2017
Carpodacus_mexicanus	-0.770	Calhim 2006	1.330	Calhim 2006	PG	Pitcher 2005; Biagolini 2017
Carpodacus_purpureus	-0.585	Calhim 2006	1.377	Calhim 2006	M	Pitcher 2005
Catharus_aurantiirostris	-0.602	Calhim 2006	1.431	Calhim 2006	M	Pitcher 2005
Catharus_fuscescens	-0.509	Calhim 2006	1.490	Calhim 2006	M	Pitcher 2005
Catharus_gracilirostris	-0.921	Calhim 2006	1.286	Calhim 2006	M	Pitcher 2005
Catharus_guttatus	-0.638	Calhim 2006	1.436	Calhim 2006	M	Pitcher 2005
Catharus_minimus	-0.292	Calhim 2006	1.533	Calhim 2006	M	Pitcher 2005
Catharus_occidentalis	-0.569	Calhim 2006	1.377	Calhim 2006	M	Pitcher 2005
Catharus_ustulatus	-0.420	Calhim 2006	1.476	Calhim 2006	M	Pitcher 2005
Centrocercus_urophasianus	0.819	Calhim 2006	3.492	Calhim 2006	PA/PGA	Biagolini 2017

Centropus_phasianinus	0.670	Calhim 2006	2.521	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Cepphus_columba	-0.387	Calhim 2006	2.687	Calhim 2006		M	Pitcher 2005
Cepphus_grylle	0.420	Calhim 2006	2.599	Calhim 2006		M	Pitcher 2005; Biagolini 2017; Szekely 2000
Cercomacra_tyrannina	-1.398	Calhim 2006	1.250	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Certhionyx_variegatus	-0.602	Calhim 2006	1.398	Calhim 2006		M	Pitcher 2005
Ceryle_rudis	0.000	Hayward 2011	1.886	Hayward 2011		C	Pitcher 2005
Chaetura_pelagica	-0.509	Calhim 2006	1.286	Calhim 2006		C	Pitcher 2005
Charadrius_bicinctus	-1.699	Calhim 2006	1.793	Calhim 2006		M	Pitcher 2005
Charadrius_dubius	-1.523	Calhim 2006	1.602	Calhim 2006		M	Pitcher 2005; Szekely 2000
Charadrius_hiaticula	-0.398	Calhim 2006	1.732	Calhim 2006		M	Pitcher 2005
Charadrius_marginatus	-1.699	Calhim 2006	1.690	Calhim 2006		M	Pitcher 2005
Charadrius_montanus	-0.409	Calhim 2006	2.006	Calhim 2006		M	Pitcher 2005
Charadrius_ruficapillus	-1.000	Calhim 2006	1.560	Calhim 2006		M	Pitcher 2005

Charadrius_semipalmatus	-1.000	Calhim 2006	1.643	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Charadrius_vociferus	-0.745	Calhim 2006	1.979	Calhim 2006		M	Pitcher 2005
Anser_caerulescens	1.243	Calhim 2006	3.420	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Chenonetta_jubata	0.310	Calhim 2006	2.911	Calhim 2006		M	Pitcher 2005
Chersomanes_albofasciata	-1.046	Calhim 2006	1.438	Calhim 2006		M	Pitcher 2005
Chionis_minor	0.021	Hayward 2011	2.704	Hayward 2011		M	Garamszegi 2005; Pitcher 2005
Chiroxiphia_caudata	-0.921	Calhim 2006	1.408	Calhim 2006	Lekking	PG	Pitcher 2005; Foster 1981
Chiroxiphia_linearis	-0.481	Calhim 2006	1.230	Calhim 2006	Lekking	PG	Pitcher 2005; Foster 1977
Chiroxiphia_pareola	-0.854	Calhim 2006	1.176	Calhim 2006	Lekking	PG	Pitcher 2005; Prum 1994 (Family is polygynous)
Chlamydera_cerviniventris	-0.495	Calhim 2006	2.243	Calhim 2006	Lekking	PG	Pitcher 2005; Lenz 1994
Chlamydera_maculata	0.318	Calhim 2006	2.152	Calhim 2006	Lekking	PG	Pitcher 2005; Lenz 1994
Chlamydera_nuchalis	-0.469	Calhim 2006	2.338	Calhim 2006	Lekking	PG	Pitcher 2005; Lenz 1994

Chlidonias_niger	-2.000	Calhim 2006	1.808	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Chloroceryle_americana	-1.046	Calhim 2006	1.462	Calhim 2006		M	Pitcher 2005
Chondestes_grammacus	-0.921	Calhim 2006	1.481	Calhim 2006			
Chordeiles_acutipennis	-1.000	Calhim 2006	1.707	Calhim 2006		M	Pitcher 2005
Chordeiles_minor	-1.097	Calhim 2006	1.815	Calhim 2006		M	Pitcher 2005
Chalcites_lucidus	-1.301	Calhim 2006	1.398	Calhim 2006		M	Pitcher 2005
Cicinnurus_regius	-0.495	Calhim 2006	1.708	Calhim 2006	Lekking	PG	Pitcher 2005; Irestedt et al 2009
Cincloramphus_mathewsi	-0.658	Calhim 2006	1.477	Calhim 2006		PG	Pitcher 2005
Cinclosoma_castaneothorax	-1.301	Calhim 2006	1.851	Calhim 2006		M	Pitcher 2005
Cinclosoma_cinnamomeum	-0.538	Calhim 2006	1.785	Calhim 2006		M	Pitcher 2005
Circus_aeruginosus	0.483	Calhim 2006	2.728	Calhim 2006		M	Pitcher 2005
Cisticola_juncidis	-0.921	Calhim 2006	1.204	Calhim 2006		PG	Pitcher 2005
Cistothorus_palustris	-0.699	Calhim 2006	1.075	Calhim 2006		PG	Pitcher 2005
Cistothorus_platensis	-0.854	Calhim 2006	0.954	Calhim 2006		PG	Pitcher 2005
Clangula_hyemalis	0.810	Calhim 2006	2.924	Calhim 2006		M	Pitcher 2005
Claravis_pretiosa	-0.387	Calhim 2006	1.856	Calhim 2006		M	Pitcher 2005

Climacteris_picumnus	-0.745	Calhim 2006	1.525	Calhim 2006		C	Pitcher 2005
Climacteris_rufus	-0.745	Calhim 2006	1.544	Calhim 2006		C	Pitcher 2005
Cnemophilus_loriae	-0.420	Calhim 2006	1.908	Calhim 2006	Lekking	PG	Pitcher 2005; Beehler 1983
Hesperiphona_vespertina	-0.444	Calhim 2006	1.752	Calhim 2006		M	Pitcher 2005
Coccyzus_americanus	-0.824	Calhim 2006	1.744	Calhim 2006		M	Pitcher 2005
Coccyzus_erythropthalmus	-0.602	Calhim 2006	1.664	Calhim 2006		M	Pitcher 2005
Cochlearius_cochlearius	0.083	Calhim 2006	2.778	Calhim 2006		M	Pitcher 2005
Coeligena_coeligena	-1.699	Calhim 2006	0.826	Calhim 2006		PG	Pitcher 2005
Coereba_flaveola	-0.444	Calhim 2006	1.000	Calhim 2006		M	Pitcher 2005
Colaptes_auratus	-0.215	Calhim 2006	2.109	Calhim 2006		PA/PGA	Pitcher 2005; Biagolini 2017
Colinus_cristatus	0.053	Calhim 2006	2.137	Calhim 2006			
Colinus_virginianus	-0.086	Calhim 2006	2.226	Calhim 2006		PG	Pitcher 2005
Colius_striatus	-0.854	Calhim 2006	1.724	Calhim 2006		C	Pitcher 2005
Aerodramus_spodiopygius	-0.886	Calhim 2006	1.021	Calhim 2006		M	Pitcher 2005
Colluricincla_harmonica	-0.143	Calhim 2006	1.792	Calhim 2006		M	Pitcher 2005
Colluricincla_megarhyncha	-0.387	Calhim 2006	1.556	Calhim 2006		M	Pitcher 2005

Colluricincla_woodwardi	-0.444	Calhim 2006	1.732	Calhim 2006	M	Pitcher 2005
Colonia_colonus	-0.585	Calhim 2006	1.212	Calhim 2006	M	Pitcher 2005
Columba_livia	0.305	Hayward 2011	2.484	Hayward 2011	M	Garamszegi 2005; Pitcher 2005
Columba_palumbus	0.230	Calhim 2006	2.667	Calhim 2006	M	Pitcher 2005
Columbina_passerina	-0.854	Calhim 2006	1.540	Calhim 2006	M	Pitcher 2005
Columbina_talpacoti	-0.959	Calhim 2006	1.668	Calhim 2006	M	Pitcher 2005
Conopophila_albogularis	-2.000	Calhim 2006	1.114	Calhim 2006	M	Pitcher 2005
Conopophila_rufogularis	-2.000	Calhim 2006	1.061	Calhim 2006	C	Pitcher 2005
Contopus_cooperi	-0.921	Calhim 2006	1.502	Calhim 2006	M	Pitcher 2005
Contopus_sordidulus	-1.222	Calhim 2006	1.146	Calhim 2006	M	Pitcher 2005
Contopus_virens	-1.046	Calhim 2006	1.196	Calhim 2006	M	Pitcher 2005
Coracina_boyeri	-1.046	Calhim 2006	1.785	Calhim 2006	M	Pitcher 2005
Coracina_caeruleogrisea	-0.357	Calhim 2006	2.176	Calhim 2006	M	Pitcher 2005
Coracina_longicauda	-0.959	Calhim 2006	1.991	Calhim 2006	M	Pitcher 2005
Coracina_montana	-1.301	Calhim 2006	1.740	Calhim 2006	M	Pitcher 2005
Coracina_novaehollandiae	-0.444	Calhim 2006	2.021	Calhim 2006	M	Pitcher 2005

Coracina_papuensis	-0.824	Calhim 2006	1.813	Calhim 2006		M	Pitcher 2005
Coracina_tenuirostris	-0.469	Calhim 2006	1.875	Calhim 2006		M	Pitcher 2005
Cormobates_leucophaeus	-0.886	Calhim 2006	1.403	Calhim 2006		M	Pitcher 2005
Corvus_brachyrhynchos	0.057	Calhim 2006	2.879	Calhim 2006		C	Biagolini 2017
Corvus_corax	0.297	Calhim 2006	3.070	Calhim 2006		M	Pitcher 2005
Corvus_corone	0.243	Hayward 2011	2.833	Hayward 2011		M	Pitcher 2005
Corvus_coronoides	-1.699	Calhim 2006	2.799	Calhim 2006		M	Pitcher 2005
Corvus_frugilegus	1.247	Hayward 2011	2.728	Hayward 2011		M	Garamszegi 2005; Pitcher 2005
Corvus_mellori	-1.398	Calhim 2006	2.732	Calhim 2006		M	Pitcher 2005
Corvus_monedula	0.580	Calhim 2006	2.369	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Corvus_splendens	0.290	Calhim 2006	2.279	Calhim 2006		M	Pitcher 2005
Coturnix_chinensis	0.250	Calhim 2006	2.061	Calhim 2006			
Coturnix_coturnix	0.477	Calhim 2006	2.111	Calhim 2006		M	Pitcher 2005
Coturnix_japonica	0.477	Hayward 2011	2.111	Hayward 2011	Lekking	PG	Pitcher 2005; Domjan 1986
Coturnix_pectoralis	0.663	Calhim 2006	2.000	Calhim 2006		M	Pitcher 2005

Cracticus_nigrogularis	0.220	Calhim 2006	2.041	Calhim 2006	C	Pitcher 2005
Crateroscelis_robusta	-0.921	Calhim 2006	1.230	Calhim 2006	C	Pitcher 2005
Crax_rubra	0.772	Calhim 2006	3.623	Calhim 2006	M	Pitcher 2005
Crex_crex	0.068	Calhim 2006	2.176	Calhim 2006	M	Pitcher 2005
Crotophaga_sulcirostris	-0.420	Calhim 2006	1.934	Calhim 2006	C	Pitcher 2005
Cyanerpes_cyaneus	-0.409	Calhim 2006	1.130	Calhim 2006	M	Pitcher 2005
Cyanocitta_cristata	-0.721	Calhim 2006	1.964	Calhim 2006	M	Pitcher 2005
Cyanocitta_stelleri	-0.462	Calhim 2006	2.075	Calhim 2006	M	Pitcher 2005; Biagolini 2017
Cyanocompsa_cyanoides	-0.444	Calhim 2006	1.477	Calhim 2006	M	Pitcher 2005
Cyanocorax_morio	0.204	Calhim 2006	2.386	Calhim 2006	C	Pitcher 2005; Biagolini 2017
Cyanocorax_sanblasianus	-0.004	Calhim 2006	1.863	Calhim 2006	C	Pitcher 2005
Cyanocorax_yncas	-0.086	Calhim 2006	1.863	Calhim 2006	C	Pitcher 2005
Cygnus_atratus	0.770	Calhim 2006	3.792	Calhim 2006	M	Pitcher 2005; Biagolini 2017
Cygnus_cygnus	1.082	Calhim 2006	4.021	Calhim 2006	M	Pitcher 2005
Cygnus_melancoryphus	0.787	Calhim 2006	3.732	Calhim 2006	M	Pitcher 2005

Cygnus_olor	0.854	Calhim 2006	4.072	Calhim 2006		M	Pitcher 2005
Cyrtonyx_montezumae	-0.046	Calhim 2006	2.277	Calhim 2006			
Dacelo_leachi	1.055	Calhim 2006	2.493	Calhim 2006		C	Pitcher 2005
Dacelo_novaeguineae	0.314	Calhim 2006	2.496	Calhim 2006		C	Griffith 2002; Pitcher 2005; Biagolini 2017
Daphoenositta_chrysoptera	-0.602	Calhim 2006	1.190	Calhim 2006		C	Pitcher 2005
Dasyornis_brachypterus	-0.745	Calhim 2006	1.623	Calhim 2006		M	Pitcher 2005
Dasyornis_broadbenti	-0.409	Calhim 2006	1.881	Calhim 2006		M	Pitcher 2005
Delichon_urbicum	-0.699	Calhim 2006	1.230	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Falcipennis_canadensis	-0.194	Calhim 2006	2.740	Calhim 2006	Lekking		Pitcher 2005
Dendragapus_obscurus	0.450	Calhim 2006	3.112	Calhim 2006	Lekking		Pitcher 2005
Dendrocincla_fuliginosa	-0.538	Calhim 2006	1.641	Calhim 2006		M	Pitcher 2005
Dendrocygna_arcuata	0.892	Calhim 2006	2.937	Calhim 2006		M	Pitcher 2005
Dendrocygna_bicolor	0.678	Calhim 2006	2.838	Calhim 2006		M	Pitcher 2005
Dendrocygna_eytoni	0.220	Calhim 2006	2.896	Calhim 2006		M	Pitcher 2005
Setophaga_adelaidae	-1.398	Calhim 2006	1.406	Calhim 2006		M	Pitcher 2005

Setophaga_caerulescens	-1.398	Calhim 2006	0.991	Calhim 2006		PG	Pitcher 2005; Biagolini 2017
Setophaga_castanea	-0.886	Calhim 2006	1.090	Calhim 2006		M	Pitcher 2005
Setophaga_cerulea	-1.000	Calhim 2006	0.959	Calhim 2006		M	Pitcher 2005
Setophaga_coronata	-0.620	Calhim 2006	1.079	Calhim 2006		M	Pitcher 2005
Setophaga_discolor	-0.602	Calhim 2006	0.954	Calhim 2006		PG	Pitcher 2005
Setophaga_fusca	-1.398	Calhim 2006	1.000	Calhim 2006		M	Pitcher 2005
Setophaga_graciae	-1.000	Calhim 2006	0.903	Calhim 2006		M	Pitcher 2005
Setophaga_magnolia	-1.155	Calhim 2006	0.944	Calhim 2006		M	Pitcher 2005
Setophaga_nigrescens	-1.046	Calhim 2006	0.954	Calhim 2006		M	Pitcher 2005
Setophaga_occidentalis	-1.046	Calhim 2006	0.991	Calhim 2006		M	Pitcher 2005
Setophaga_palmarum	-1.155	Calhim 2006	1.013	Calhim 2006		PG	Pitcher 2005
Setophaga_pensylvanica	-1.097	Calhim 2006	0.982	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Setophaga_petechia	-0.770	Calhim 2006	0.982	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Setophaga_pharetra	-1.046	Calhim 2006	1.013	Calhim 2006		M	Pitcher 2005
Setophaga_pinus	-1.000	Calhim 2006	1.068	Calhim 2006		M	Pitcher 2005

Setophaga_plumbea	-1.000	Calhim 2006	1.041	Calhim 2006		M	Pitcher 2005
Setophaga_striata	-0.886	Calhim 2006	1.100	Calhim 2006		PG	Pitcher 2005
Setophaga_tigrina	-0.886	Calhim 2006	1.053	Calhim 2006		M	Pitcher 2005
Setophaga_virens	-0.959	Calhim 2006	0.964	Calhim 2006		M	Pitcher 2005
Setophaga_vitellina	-0.959	Calhim 2006	0.908	Calhim 2006		M	Pitcher 2005
Dicaeum_hirundinaceum	-0.854	Calhim 2006	0.929	Calhim 2006		M	Pitcher 2005
Dicaeum_pectorale	-1.155	Calhim 2006	0.740	Calhim 2006		M	Pitcher 2005
Dicrurus_bracteatus	-1.699	Calhim 2006	1.984	Calhim 2006		M	Pitcher 2005
Dicrurus_hottentottus	-0.481	Calhim 2006	1.914	Calhim 2006		M	Pitcher 2005
Diomedea_exulans	1.774	Hayward 2011	3.934	Hayward 2011		M	Garamszegi 2005; Pitcher 2005; Biagolini 2017
Dolichonyx_oryzivorus	-0.409	Calhim 2006	1.672	Calhim 2006		PG	Pitcher 2005
Dromaius_novaehollandiae	2.103	Hayward 2011	4.544	Hayward 2011		M	Garamszegi 2005
Drymodes_brunneopygia	-0.456	Calhim 2006	1.568	Calhim 2006		M	Pitcher 2005
Dumetella_carolinensis	-0.658	Calhim 2006	1.544	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Eclectus_roratus	0.274	Calhim 2006	2.631	Calhim 2006		C	Pitcher 2005

Egretta_caerulea	-0.658	Calhim 2006	2.561	Calhim 2006		M	Pitcher 2005
Egretta_thula	-0.102	Calhim 2006	2.568	Calhim 2006		M	Pitcher 2005
Egretta_tricolor	0.713	Calhim 2006	2.648	Calhim 2006		M	Pitcher 2005
Elaenia_flavogaster	-0.745	Calhim 2006	1.380	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Elseyornis_melanops	-1.699	Calhim 2006	1.477	Calhim 2006		M	Pitcher 2005
Emberiza_bruniceps	-0.796	Calhim 2006	1.415	Calhim 2006		M	Pitcher 2005
Emberiza_citrinella	-0.292	Calhim 2006	1.436	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Emberiza_melanocephala	-0.481	Calhim 2006	1.447	Calhim 2006		M	Pitcher 2005
Emberiza_schoeniclus	-0.282	Hayward 2011	1.262	Hayward 2011		PG	Pitcher 2005; Biagolini 2017
Emberizoides_herbicola	-0.824	Calhim 2006	1.398	Calhim 2006		M	Pitcher 2005
Empidonax_affinis	-0.886	Calhim 2006	1.021	Calhim 2006		M	Pitcher 2005
Empidonax_alnorum	-0.921	Calhim 2006	1.121	Calhim 2006		M	Pitcher 2005
Empidonax_atriceps	-1.222	Calhim 2006	0.954	Calhim 2006		M	Pitcher 2005
Empidonax_difficilis	-1.155	Calhim 2006	1.000	Calhim 2006		M	Pitcher 2005
Empidonax_flaviventris	-1.000	Calhim 2006	1.075	Calhim 2006		M	Pitcher 2005

Empidonax_hammondii	-1.155	Calhim 2006	1.029	Calhim 2006		M	Pitcher 2005
Empidonax_minimus	-0.721	Calhim 2006	1.029	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Empidonax_traillii	-0.886	Calhim 2006	1.114	Calhim 2006		PG	Pitcher 2005; Biagolini 2017
Empidonax_virescens	-1.155	Calhim 2006	1.117	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Empidonax_wrightii	-1.398	Calhim 2006	1.097	Calhim 2006		M	Pitcher 2005
Entomyzon_cyanotis	-0.032	Calhim 2006	2.009	Calhim 2006		M	Pitcher 2005
Eopsaltria_australis	-0.523	Calhim 2006	1.279	Calhim 2006		C	Pitcher 2005
Eopsaltria_georgiana	-1.301	Calhim 2006	1.255	Calhim 2006		C	Pitcher 2005
Epthianura_albifrons	-1.046	Calhim 2006	1.079	Calhim 2006		M	Pitcher 2005
Epthianura_aurifrons	-0.678	Calhim 2006	1.000	Calhim 2006		M	Pitcher 2005
Epthianura_crocea	-0.658	Calhim 2006	0.903	Calhim 2006		M	Pitcher 2005
Epthianura_tricolor	-1.097	Hayward 2011	1.000	Hayward 2011		M	Garamszegi 2005; Pitcher 2005
Eremalauda_starki	-1.222	Calhim 2006	1.265	Calhim 2006		M	Pitcher 2005
Eremophila_alpestris	-0.357	Calhim 2006	1.513	Calhim 2006		M	Pitcher 2005

Eremopterix_verticalis	-1.046	Calhim 2006	1.225	Calhim 2006		M	Pitcher 2005
Erithacus_rubecula	-0.638	Calhim 2006	1.260	Calhim 2006			
Charadrius_morinellus	0.121	Calhim 2006	2.053	Calhim 2006		PA/PGA	Pitcher 2005; Biagolini 2017; Szekely 2000
Eudynamys_scolopaceus	-0.377	Calhim 2006	2.377	Calhim 2006		M	Pitcher 2005
Eudyptula_minor	0.204	Calhim 2006	3.069	Calhim 2006		M	Pitcher 2005
Eulacestoma_nigropectus	-0.854	Calhim 2006	1.290	Calhim 2006		M	Pitcher 2005
Euphagus_carolinus	-0.538	Calhim 2006	1.766	Calhim 2006		M	Pitcher 2005
Euphagus_cyanocephalus	0.093	Calhim 2006	1.839	Calhim 2006		PG	Pitcher 2005
Euplectes_orix	-0.268	Calhim 2006	1.362	Calhim 2006		PG	Pitcher 2005; Biagolini 2017
Eurypyga_helias	-0.620	Calhim 2006	2.356	Calhim 2006		M	Pitcher 2005
Falco_berigora	-0.509	Calhim 2006	2.656	Calhim 2006		M	Pitcher 2005
Falco_columbarius	-0.721	Calhim 2006	2.238	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Falco_mexicanus	0.597	Calhim 2006	2.740	Calhim 2006		M	Pitcher 2005
Falco_peregrinus	-1.046	Calhim 2006	2.786	Calhim 2006		M	Pitcher 2005;

							Biagolini 2017
Falco_sparverius	0.324	Calhim 2006	1.978	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Falco_tinnunculus	-0.143	Hayward 2011	2.283	Hayward 2011		PA/PGA	Garamszegi 2005; Pitcher 2005; Biagolini 2017
Falcunculus_frontatus	-0.481	Calhim 2006	1.477	Calhim 2006		C	Pitcher 2005
Ficedula_albicollis	-1.398	Calhim 2006	1.013	Calhim 2006		PG	Pitcher 2005; Biagolini 2017
Ficedula_hypoleuca	-1.398	Hayward 2011	1.064	Hayward 2011		PG	Pitcher 2005; Biagolini 2017
Formicarius_analis	-0.310	Calhim 2006	1.769	Calhim 2006		M	Pitcher 2005
Formicarius_nigricapillus	-0.796	Calhim 2006	1.886	Calhim 2006		M	Pitcher 2005
Francolinus_africanus	0.204	Calhim 2006	2.643	Calhim 2006			
Francolinus_sephaena	0.167	Calhim 2006	2.602	Calhim 2006			
Fratercula_arctica	0.322	Calhim 2006	2.653	Calhim 2006		M	Pitcher 2005; Biagolini 2017; Szekely 2000

Fratercula_corniculata	-0.699	Calhim 2006	2.804	Calhim 2006		M	Pitcher 2005
Fregata_magnificens	0.436	Calhim 2006	3.233	Calhim 2006		M	Pitcher 2005
Fringilla_coelebs	-0.357	Hayward 2011	1.064	Hayward 2011		M	Pitcher 2005; Biagolini 2017
Fulmarus_glacialis	0.387	Calhim 2006	2.914	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Galbula_albirostris	-0.959	Calhim 2006	1.342	Calhim 2006		M	Pitcher 2005
Galerida_cristata	-0.481	Calhim 2006	1.602	Calhim 2006		M	Pitcher 2005
Gallinago_media	0.134	Calhim 2006	2.196	Calhim 2006		PG	Szekely 2000
Gallinula_chloropus	0.167	Calhim 2006	2.531	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Gallus_gallus	1.447	Hayward 2011	3.362	Hayward 2011	Lekking	PG	Garamszegi 2005; Pitcher 2005
Gavia_adamsii	0.121	Calhim 2006	3.750	Calhim 2006		M	Pitcher 2005
Gavia_arctica	-0.143	Calhim 2006	3.382	Calhim 2006		M	Pitcher 2005
Gavia_immer	0.090	Calhim 2006	3.737	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Gavia_stellata	-0.018	Calhim 2006	3.277	Calhim 2006		M	Pitcher 2005

Geococcyx_californianus	-0.444	Calhim 2006	2.575	Calhim 2006		M	Pitcher 2005
Geopelia_striata	-0.456	Calhim 2006	1.699	Calhim 2006		M	Pitcher 2005
Geothlypis_trichas	-0.678	Calhim 2006	1.021	Calhim 2006		PG	Pitcher 2005; Biagolini 2017
Gerygone_chloronota	-1.699	Calhim 2006	0.806	Calhim 2006		M	Pitcher 2005
Gerygone_chrysogaster	-1.097	Calhim 2006	0.869	Calhim 2006		C	Pitcher 2005
Gerygone_cinerea	-1.699	Calhim 2006	0.845	Calhim 2006		M	Pitcher 2005
Gerygone_fusca	-1.097	Calhim 2006	0.857	Calhim 2006		M	Pitcher 2005
Gerygone_levigaster	-0.602	Calhim 2006	0.869	Calhim 2006		M	Pitcher 2005
Gerygone_magnirostris	-0.721	Calhim 2006	0.857	Calhim 2006		C	Pitcher 2005
Gerygone_mouki	-0.538	Calhim 2006	0.792	Calhim 2006		C	Pitcher 2005
Gerygone_olivacea	-1.000	Calhim 2006	0.892	Calhim 2006		M	Pitcher 2005
Glycichaera_fallax	-1.301	Calhim 2006	1.061	Calhim 2006		M	Pitcher 2005
Grallina_cyanoleuca	0.127	Calhim 2006	1.677	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Grus_canadensis	0.894	Calhim 2006	3.653	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Grus_grus	1.061	Calhim 2006	3.699	Calhim 2006		M	Pitcher 2005

Guira_guira	0.243	Calhim 2006	2.143	Calhim 2006	C	Pitcher 2005
Gymnopithys_leucaspis	-1.097	Hayward 2011	1.493	Hayward 2011	M	Garamszegi 2005; Pitcher 2005
Gymnorhina_tibicen	0.330	Hayward 2011	2.496	Hayward 2011	C	Pitcher 2005; Biagolini 2017
Gymnorhinus_cyanocephalus	0.299	Calhim 2006	2.033	Calhim 2006	M	Pitcher 2005
Gypaetus_barbatus	1.526	Calhim 2006	3.653	Calhim 2006	M	Pitcher 2005
Haematopus_bachmani	-0.319	Calhim 2006	2.784	Calhim 2006	M	Pitcher 2005
Haematopus_ostralegus	-0.268	Calhim 2006	2.724	Calhim 2006	M	Pitcher 2005; Biagolini 2017; Szekely 2000
Haematopus_palliatus	-0.509	Calhim 2006	2.777	Calhim 2006	M	Pitcher 2005
Haematopus_unicolor	-0.959	Calhim 2006	2.857	Calhim 2006	M	Pitcher 2005
Haliastur_sphenurus	-0.027	Calhim 2006	2.854	Calhim 2006	M	Pitcher 2005
Heliornis_fulica	-1.398	Calhim 2006	2.130	Calhim 2006	M	Pitcher 2005
Poecilodryas_albispecularis	-0.745	Calhim 2006	1.568	Calhim 2006	M	Pitcher 2005
Hieraaetus_morphnoides	-0.229	Calhim 2006	2.826	Calhim 2006	M	Pitcher 2005
Hirundo_neoxena	-0.824	Calhim 2006	1.176	Calhim 2006	M	Pitcher 2005

Hirundo_nigricans	-0.854	Calhim 2006	1.155	Calhim 2006	M	Pitcher 2005
Hirundo_rustica	-0.260	Hayward 2011	1.279	Hayward 2011	PG	Pitcher 2005; Biagolini 2017
Hirundo_tahitica	-1.046	Calhim 2006	1.176	Calhim 2006	M	Pitcher 2005
Histrionicus_histrionicus	0.083	Calhim 2006	2.815	Calhim 2006	M	Pitcher 2005
Calamanthus_cautus	-0.854	Calhim 2006	1.176	Calhim 2006	M	Pitcher 2005
Hylophilus_decurtatus	-1.398	Calhim 2006	1.000	Calhim 2006		
Hylophilus_ochraceiceps	-1.699	Calhim 2006	1.041	Calhim 2006	M	Pitcher 2005
Hylophylax_naevioides	-1.000	Hayward 2011	1.230	Hayward 2011	M	Garamszegi 2005
Hymenolaimus_malacorhynchos	-0.076	Calhim 2006	2.921	Calhim 2006	M	Pitcher 2005; Biagolini 2017
Icteria_virens	-0.301	Calhim 2006	1.408	Calhim 2006	M	Pitcher 2005
Icterus_bullockii	-0.102	Calhim 2006	1.582	Calhim 2006	M	Pitcher 2005
Icterus_galbula	-0.161	Calhim 2006	1.554	Calhim 2006	M	Pitcher 2005; Biagolini 2017
Icterus_leucopteryx	-0.194	Calhim 2006	1.677	Calhim 2006		
Icterus_parisorum	-0.469	Calhim 2006	1.579	Calhim 2006	M	Pitcher 2005
Icterus_pectoralis	-0.444	Calhim 2006	1.719	Calhim 2006	M	Pitcher 2005

Icterus_spurius	-0.252	Calhim 2006	1.326	Calhim 2006		M	Pitcher 2005
Ixobrychus_exilis	-0.770	Calhim 2006	1.889	Calhim 2006		M	Pitcher 2005
Jacana_spinosa	-0.027	Calhim 2006	1.954	Calhim 2006		PA/PGA	Pitcher 2005; Szekely 2000
Junco_hyemalis	-0.538	Hayward 2011	1.322	Hayward 2011		M	Garamszegi 2005; Pitcher 2005; Biagolini 2017
Jynx_torquilla	-0.585	Calhim 2006	1.491	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Lagopus_lagopus	0.176	Hayward 2011	2.845	Hayward 2011		PG	Pitcher 2005; Biagolini 2017
Lagopus_leucura	-0.398	Calhim 2006	2.555	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Lagopus_muta	0.604	Calhim 2006	2.681	Calhim 2006		M	Pitcher 2005
Lalage_atrovirens	-1.097	Calhim 2006	1.512	Calhim 2006		M	Pitcher 2005
Lalage_tricolor	-1.097	Calhim 2006	1.406	Calhim 2006		C	Pitcher 2005
Lamprotornis_chalybaeus	-0.319	Hayward 2011	1.968	Hayward 2011		M	Garamszegi 2005
Lamprotornis_pulcher	-0.252	Calhim 2006	1.996	Calhim 2006		C	Pitcher 2005

Lamprotornis_purpuroptera	-0.959	Hayward 2011	1.778	Hayward 2011	M	Garamszegi 2005
Lanius_collaris	-0.678	Hayward 2011	1.580	Hayward 2011	C	Pitcher 2005
Lanius_collurio	-0.620	Hayward 2011	1.450	Hayward 2011	C	Griffith 2002; Biagolini 2017
Lanius_cristatus	-0.538	Calhim 2006	1.477	Calhim 2006	M	Pitcher 2005
Lanius_schach	-0.553	Calhim 2006	1.556	Calhim 2006	M	Pitcher 2005
Larus_argentatus	0.398	Calhim 2006	3.047	Calhim 2006	M	Pitcher 2005; Szekely 2000
Larus_californicus	0.589	Calhim 2006	2.839	Calhim 2006	M	Pitcher 2005
Larus_canus	0.196	Calhim 2006	2.636	Calhim 2006	M	Pitcher 2005; Biagolini 2017
Larus_delawarensis	0.274	Calhim 2006	2.753	Calhim 2006	PG	Pitcher 2005
Larus_fuscus	0.322	Calhim 2006	2.950	Calhim 2006	M	Pitcher 2005
Larus_glaucescens	0.346	Calhim 2006	3.031	Calhim 2006	M	Pitcher 2005
Larus_marinus	0.577	Calhim 2006	3.257	Calhim 2006	M	Pitcher 2005
Larus_occidentalis	0.307	Hayward 2011	3.053	Hayward 2011	M	Garamszegi 2005; Biagolini 2017
Chroicocephalus_ridibundus	-0.377	Hayward 2011	2.439	Hayward 2011	M	Garamszegi 2005;

							Biagolini 2017
Legatus_leucophaius	-1.398	Calhim 2006	1.362	Calhim 2006		M	Pitcher 2005
Lepidothrix_coronata	-0.796	Calhim 2006	0.908	Calhim 2006	Lekking	PG	Pitcher 2005; Prum 1994 (Family is polygynous)
Leucosticte_arctoa	-0.523	Calhim 2006	1.431	Calhim 2006		M	Pitcher 2005
Lichenostomus_flavus	-2.000	Calhim 2006	1.322	Calhim 2006		M	Pitcher 2005
Lichenostomus_leucotis	-0.456	Calhim 2006	1.398	Calhim 2006		M	Pitcher 2005
Lichenostomus_ornatus	-0.523	Calhim 2006	1.290	Calhim 2006		M	Pitcher 2005
Lichenostomus_penicillatus	-0.824	Hayward 2011	1.322	Hayward 2011		C	Pitcher 2005
Lichenostomus_virescens	-0.678	Calhim 2006	1.415	Calhim 2006		M	Pitcher 2005
Limnodromus_griseus	-0.721	Calhim 2006	2.049	Calhim 2006		M	Pitcher 2005
Limnodromus_scolopaceus	-0.796	Calhim 2006	2.000	Calhim 2006		M	Pitcher 2005
Limnothlypis_swainsonii	-0.638	Calhim 2006	1.133	Calhim 2006		M	Pitcher 2005
Limosa_fedoa	-0.398	Calhim 2006	2.497	Calhim 2006		M	Pitcher 2005
Limosa_haemastica	-0.770	Calhim 2006	2.403	Calhim 2006		M	Pitcher 2005
Limosa_lapponica	-0.745	Calhim 2006	2.490	Calhim 2006		M	Pitcher 2005
Limosa_limosa	-0.328	Calhim 2006	2.435	Calhim 2006		M	Pitcher 2005;

							Szekely 2000
Loboparadisea_sericea	-0.328	Calhim 2006	1.778	Calhim 2006	Lekking	PG	Pitcher 2005; Beehler 1983
Locustella_fluviatilis	-0.658	Calhim 2006	1.260	Calhim 2006			
Locustella_luscinioides	-1.155	Calhim 2006	1.176	Calhim 2006		M	Biagolini 2017
Lonchura_castaneothorax	-1.046	Calhim 2006	1.114	Calhim 2006		M	Pitcher 2005
Lonchura_punctulata	-0.983	Calhim 2006	1.146	Calhim 2006		PG	Pitcher 2005
Lonchura_striata	-1.155	Hayward 2011	1.053	Hayward 2011		M	Garamszegi 2005; Pitcher 2005
Lophorina_superba	-0.167	Calhim 2006	1.959	Calhim 2006	Lekking	PG	Pitcher 2005; Hoglund 1989; Irestedt et al 2009
Lophura_leucomelanos	0.555	Calhim 2006	2.900	Calhim 2006		C	Biagolini 2017
Loxia_curvirostra	-0.796	Calhim 2006	1.633	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Loxia_leucoptera	-0.959	Calhim 2006	1.444	Calhim 2006		M	Pitcher 2005
Luscinia_svecica	-0.620	Calhim 2006	1.230	Calhim 2006		M	Pitcher 2005; Biagolini 2017

Malurus_amabilis	-0.678	Calhim 2006	0.954	Calhim 2006		C	Pitcher 2005
Malurus_coronatus	-1.301	Calhim 2006	1.161	Calhim 2006		C	Pitcher 2005; Biagolini 2017
Malurus_cyaneus	-0.319	Hayward 2011	0.991	Hayward 2011		C	Griffith 2002; Pitcher 2005; Biagolini 2017
Malurus_elegans	-0.337	Calhim 2006	1.029	Calhim 2006		C	Pitcher 2005; Biagolini 2017
Malurus_lamberti	-0.602	Hayward 2011	0.892	Hayward 2011		C	Pitcher 2005
Malurus_leucopterus	-0.481	Hayward 2011	0.968	Hayward 2011		C	Pitcher 2005
Malurus_melanocephalus	-0.310	Calhim 2006	0.949	Calhim 2006		C	Pitcher 2005; Biagolini 2017
Malurus_pulcherrimus	-0.745	Calhim 2006	0.924	Calhim 2006		C	Pitcher 2005
Malurus_splendens	-0.319	Calhim 2006	1.000	Calhim 2006		C	Pitcher 2005; Biagolini 2017
Manacus_manacus	-0.444	Calhim 2006	1.146	Calhim 2006	Lekking	PG	Pitcher 2005; Prum 1994 (Family is polygynous)
Manacus_vitellinus	-0.854	Hayward 2011	1.286	Hayward 2011	Lekking	PG	Prum 1994

Manorina_flavigula	-0.420	Hayward 2011	1.763	Hayward 2011	C	Pitcher 2005
Manorina_melanocephala	-0.585	Calhim 2006	1.748	Calhim 2006	C	Griffith 2002; Pitcher 2005; Biagolini 2017
Manorina_melanophrys	-0.721	Hayward 2011	1.477	Hayward 2011	C	Griffith 2002; Biagolini 2017
Manucodia_ater	-0.886	Calhim 2006	2.279	Calhim 2006	M	Pitcher 2005
Manucodia_chalybatus	0.380	Calhim 2006	2.362	Calhim 2006	M	Pitcher 2005
Manucodia_jobiensis	-0.959	Calhim 2006	2.332	Calhim 2006	M	Pitcher 2005
Manucodia_keraudrenii	0.358	Calhim 2006	2.207	Calhim 2006	M	Pitcher 2005
Margarornis_squamiger	-1.523	Calhim 2006	1.258	Calhim 2006	M	Pitcher 2005
Megaceryle_alcyon	-0.770	Calhim 2006	2.124	Calhim 2006	M	Pitcher 2005
Megalurus_gramineus	-0.959	Calhim 2006	1.255	Calhim 2006	M	Pitcher 2005
Megapodius_reinwardt	0.037	Calhim 2006	3.041	Calhim 2006	M	Pitcher 2005
Melanerpes_aurifrons	-0.409	Calhim 2006	1.937	Calhim 2006	M	Pitcher 2005
Melanerpes_carolinus	-0.770	Calhim 2006	1.859	Calhim 2006	M	Pitcher 2005
Melanerpes_erythrocephalus	-1.222	Calhim 2006	1.862	Calhim 2006	M	Pitcher 2005
Melanerpes_formicivorus	-0.032	Calhim 2006	1.806	Calhim 2006	C	Griffith 2002;

							Pitcher 2005; Biagolini 2017
Melanerpes_herminieri	-1.097	Calhim 2006	2.000	Calhim 2006		M	Pitcher 2005
Melanitta_fusca	0.236	Calhim 2006	3.302	Calhim 2006		M	Pitcher 2005
Melanitta_nigra	0.653	Calhim 2006	2.978	Calhim 2006		M	Pitcher 2005
Melanocharis_nigra	-0.921	Calhim 2006	1.000	Calhim 2006		M	Pitcher 2005
Melanocharis_versteri	-1.222	Calhim 2006	1.041	Calhim 2006		M	Pitcher 2005
Melanodryas_cucullata	-0.357	Calhim 2006	1.322	Calhim 2006		C	Pitcher 2005
Melanodryas_vittata	-0.420	Calhim 2006	1.423	Calhim 2006		C	Pitcher 2005
Meleagris_gallopavo	1.447	Hayward 2011	4.204	Hayward 2011	Lekking	PG	Garamszegi 2005; Pitcher 2005; Beletsky 1995
Melidectes_belfordi	-0.143	Calhim 2006	1.914	Calhim 2006		C	Pitcher 2005
Melidectes_ochromelas	-0.745	Calhim 2006	1.839	Calhim 2006		M	Pitcher 2005
Melidectes_torquatus	-0.337	Calhim 2006	1.699	Calhim 2006		M	Pitcher 2005
Melilestes_megarhynchus	-0.310	Calhim 2006	1.643	Calhim 2006		M	Pitcher 2005
Meliphaga_analoga	-0.796	Calhim 2006	1.322	Calhim 2006		M	Pitcher 2005
Meliphaga_gracilis	-1.699	Calhim 2006	1.161	Calhim 2006		M	Pitcher 2005

Meliphaga_lewinii	-0.310	Calhim 2006	1.602	Calhim 2006			M	Pitcher 2005
Meliphaga_montana	-0.638	Calhim 2006	1.415	Calhim 2006			M	Pitcher 2005
Meliphaga_notata	-0.745	Calhim 2006	1.398	Calhim 2006			M	Pitcher 2005
Melipotes_fumigatus	-0.824	Calhim 2006	1.690	Calhim 2006			M	Pitcher 2005
Melithreptus_albogularis	-1.155	Calhim 2006	1.079	Calhim 2006			C	Pitcher 2005
Melithreptus_brevirostris	-0.409	Calhim 2006	1.260	Calhim 2006			C	Pitcher 2005
Melithreptus_lunatus	-0.721	Calhim 2006	1.267	Calhim 2006			C	Pitcher 2005
Melopsittacus_undulatus	-0.569	Calhim 2006	1.505	Calhim 2006			M	Pitcher 2005
Melospiza_georgiana	-0.161	Calhim 2006	1.255	Calhim 2006			M	Pitcher 2005; Biagolini 2017
Melospiza_lincolnii	-0.328	Calhim 2006	1.241	Calhim 2006			M	Pitcher 2005
Melospiza_melodia	-0.420	Hayward 2011	1.322	Hayward 2011			PG	Pitcher 2005; Biagolini 2017
Melozone_kieneri	-0.237	Calhim 2006	1.678	Calhim 2006			M	Pitcher 2005
Menura_novaehollandiae	0.364	Calhim 2006	3.072	Calhim 2006	Lekking			Pitcher 2005
Mergus_merganser	0.720	Calhim 2006	3.233	Calhim 2006			M	Pitcher 2005
Mergus_serrator	1.124	Calhim 2006	3.056	Calhim 2006			M	Pitcher 2005
Merops_apiaster	-0.854	Calhim 2006	1.753	Calhim 2006			C	Pitcher 2005

Merops_ornatus	-2.000	Calhim 2006	1.459	Calhim 2006		C	Pitcher 2005
Microcerculus_marginatus	-0.796	Calhim 2006	1.258	Calhim 2006			
Microeca_fascinans	-0.237	Calhim 2006	1.079	Calhim 2006		M	Pitcher 2005
Microeca_flavigaster	-0.721	Calhim 2006	1.130	Calhim 2006		M	Pitcher 2005
Microeca_papuana	-0.310	Calhim 2006	1.021	Calhim 2006		C	Pitcher 2005
Miliaria_calandra	-0.337	Calhim 2006	1.681	Calhim 2006		PG	Pitcher 2005; Biagolini 2017
Milvus_migrans	0.516	Calhim 2006	2.791	Calhim 2006		M	Pitcher 2005
Mimus_polyglottos	-0.602	Calhim 2006	1.699	Calhim 2006		M	Garamszegi 2005; Pitcher 2005
Mino_dumontii	-0.387	Calhim 2006	2.447	Calhim 2006		C	Pitcher 2005
Mionectes_macconnelli	-0.796	Calhim 2006	1.176	Calhim 2006	Lekking		Pitcher 2005
Mionectes_rufiventris	-1.699	Calhim 2006	1.146	Calhim 2006	Lekking		Pitcher 2005
Mniotilta_varia	-1.097	Calhim 2006	0.996	Calhim 2006		M	Pitcher 2005
Molothrus_ater	-0.056	Hayward 2011	1.643	Hayward 2011		M	Garamszegi 2005; Pitcher 2005
Molothrus_bonariensis	-0.538	Calhim 2006	1.592	Calhim 2006		M	Pitcher 2005
Monarcha_axillaris	-0.824	Calhim 2006	1.061	Calhim 2006		M	Pitcher 2005

Monarcha_chrysomela	-0.745	Calhim 2006	1.146	Calhim 2006		M	Pitcher 2005
Monarcha_guttula	-0.244	Calhim 2006	1.161	Calhim 2006		M	Pitcher 2005
Monarcha_melanopsis	-0.398	Calhim 2006	1.362	Calhim 2006		M	Pitcher 2005
Monarcha_trivirgatus	-0.337	Calhim 2006	1.130	Calhim 2006		M	Pitcher 2005
Motacilla_alba	0.041	Calhim 2006	1.362	Calhim 2006		M	Pitcher 2005
Motacilla_flava	-0.432	Calhim 2006	1.230	Calhim 2006		M	Pitcher 2005
Myiagra_alecto	-1.699	Calhim 2006	1.322	Calhim 2006		M	Pitcher 2005
Myiagra_inquieta	-0.444	Calhim 2006	1.097	Calhim 2006		M	Pitcher 2005
Myiagra_rubecula	-0.377	Calhim 2006	1.146	Calhim 2006		C	Pitcher 2005
Myiarchus_cinerascens	-0.602	Calhim 2006	1.462	Calhim 2006		M	Pitcher 2005
Myiarchus_crinitus	-0.409	Calhim 2006	1.552	Calhim 2006		M	Pitcher 2005
Myiarchus_tuberculifer	-0.745	Calhim 2006	1.299	Calhim 2006		M	Pitcher 2005
Myiarchus_tyrannulus	-0.387	Calhim 2006	1.599	Calhim 2006		M	Pitcher 2005
Myiobius_barbatus	-1.301	Calhim 2006	1.079	Calhim 2006	Lekking		Pitcher 2005
Myioborus_miniatus	-1.046	Calhim 2006	1.146	Calhim 2006		M	Pitcher 2005
Myioborus_pictus	-0.721	Calhim 2006	0.973	Calhim 2006		PG	Pitcher 2005
Myiodynastes_maculatus	-0.481	Calhim 2006	1.633	Calhim 2006		M	Pitcher 2005

Myiopagis_gaimardii	-1.301	Calhim 2006	1.079	Calhim 2006		M	Pitcher 2005
Myiopagis_viridicata	-1.398	Calhim 2006	1.146	Calhim 2006		M	Pitcher 2005
Myzomela_erythrocephala	-0.770	Calhim 2006	0.929	Calhim 2006		M	Pitcher 2005
Myzomela_obscura	-1.046	Calhim 2006	1.079	Calhim 2006		M	Pitcher 2005
Myzomela_rosenbergii	-0.921	Calhim 2006	0.875	Calhim 2006		M	Pitcher 2005
Myzomela_sanguinolenta	-0.824	Calhim 2006	0.845	Calhim 2006		M	Pitcher 2005
Nectarinia_jugularis	-0.824	Calhim 2006	0.929	Calhim 2006		M	Pitcher 2005
Neochmia_modesta	-1.398	Calhim 2006	1.124	Calhim 2006		M	Pitcher 2005
Neochmia_phaeton	-1.301	Calhim 2006	0.903	Calhim 2006		M	Pitcher 2005
Neochmia_ruficauda	-1.155	Calhim 2006	1.000	Calhim 2006		M	Pitcher 2005
Neochmia_temporalis	-1.523	Calhim 2006	0.954	Calhim 2006		M	Pitcher 2005
Ninox_boobook	-0.824	Calhim 2006	2.395	Calhim 2006		M	Pitcher 2005
Notharchus_macrorhynchos	-1.097	Calhim 2006	2.079	Calhim 2006		M	Pitcher 2005
Nothoprocta_cinerascens	0.496	Calhim 2006	3.000	Calhim 2006		PA/PGA	Pitcher 2005
Numenius_phaeopus	-0.456	Calhim 2006	2.591	Calhim 2006		M	Pitcher 2005
Numida_meleagris	0.577	Calhim 2006	3.267	Calhim 2006		M	Pitcher 2005
Nyctibius_griseus	-0.585	Calhim 2006	2.384	Calhim 2006		M	Pitcher 2005

Nycticorax_nycticorax	0.037	Calhim 2006	2.960	Calhim 2006		M	Pitcher 2005
Nymphicus_hollandicus	-1.155	Calhim 2006	1.929	Calhim 2006		M	Pitcher 2005
Oceanodroma_leucorhoa	-1.699	Calhim 2006	1.500	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Oceanodroma_melania	-0.469	Calhim 2006	1.694	Calhim 2006		M	Pitcher 2005
Ocyphaps_lophotes	0.097	Calhim 2006	2.316	Calhim 2006		M	Pitcher 2005
Oenanthe_oenanthe	-0.149	Calhim 2006	1.415	Calhim 2006		PG	Pitcher 2005; Biagolini 2017
Onychorhynchus_coronatus	-0.745	Calhim 2006	1.270	Calhim 2006		M	Pitcher 2005
Geothlypis_formosa	-0.638	Calhim 2006	1.121	Calhim 2006		M	Pitcher 2005
Geothlypis_philadelphia	-0.824	Calhim 2006	1.075	Calhim 2006		M	Pitcher 2005
Geothlypis_tolmiei	-0.824	Calhim 2006	1.025	Calhim 2006		M	Pitcher 2005
Oreoica_gutturalis	-0.208	Calhim 2006	1.799	Calhim 2006		M	Pitcher 2005
Oreopsar_bolivianus	-0.066	Calhim 2006	1.868	Calhim 2006		M	Pitcher 2005
Oreortyx_pictus	0.029	Calhim 2006	2.378	Calhim 2006			
Oriolus_flavocinctus	0.572	Calhim 2006	2.121	Calhim 2006		M	Pitcher 2005
Oriolus_sagittatus	0.000	Calhim 2006	1.964	Calhim 2006		M	Pitcher 2005
Oriolus_szalayi	-0.745	Calhim 2006	2.021	Calhim 2006		M	Pitcher 2005

Ortalis_motmot	-0.131	Calhim 2006	2.626	Calhim 2006		M	Pitcher 2005
Ortalis_vetula	0.299	Calhim 2006	2.822	Calhim 2006		M	Pitcher 2005
Orthonyx_spaldingii	-1.301	Calhim 2006	2.185	Calhim 2006		M	Pitcher 2005
Orthonyx_temminckii	-1.523	Calhim 2006	1.819	Calhim 2006		C	Pitcher 2005
Oxyura_australis	1.311	Calhim 2006	2.910	Calhim 2006	Lekking	M	Pitcher 2005; Scott 1990
Oxyura_maccoa	-0.959	Calhim 2006	2.825	Calhim 2006	Lekking	M	Pitcher 2005; Scott 1990
Pachycephala_inornata	-0.347	Calhim 2006	1.556	Calhim 2006		M	Pitcher 2005
Pachycephala_olivacea	-0.222	Calhim 2006	1.602	Calhim 2006		M	Pitcher 2005
Pachycephala_pectoralis	-0.229	Calhim 2006	1.431	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Pachycephala_rufiventris	-1.000	Hayward 2011	1.301	Hayward 2011		M	Garamszegi 2005; Pitcher 2005
Pachycephala_schlegelii	-0.337	Calhim 2006	1.279	Calhim 2006		M	Pitcher 2005
Pachycephala_simplex	-0.745	Calhim 2006	1.267	Calhim 2006		M	Pitcher 2005
Pachycephala_soror	-0.244	Calhim 2006	1.371	Calhim 2006		M	Pitcher 2005
Pandion_haliaetus	1.247	Calhim 2006	3.154	Calhim 2006		M	Pitcher 2005
Panurus_biarmicus	-0.561	Calhim 2006	1.196	Calhim 2006		M	Pitcher 2005;

							Biagolini 2017
Paradisaea_apoda	-0.131	Calhim 2006	2.398	Calhim 2006	Lekking	PG	Pitcher 2005; Hoglund 1989; Irestedt et al 2009
Paradisaea_guilielmi	-0.125	Calhim 2006	2.403	Calhim 2006	Lekking	PG	Pitcher 2005; Hoglund 1989; Irestedt et al 2009
Paradisaea_minor	-0.018	Calhim 2006	2.358	Calhim 2006	Lekking	PG	Pitcher 2005; Hoglund 1989; Irestedt et al 2009
Paradisaea_raggiana	-0.004	Calhim 2006	2.476	Calhim 2006	Lekking	PG	Pitcher 2005; Hoglund 1989; Irestedt et al 2009
Paradisaea_rudolphi	-0.260	Calhim 2006	2.207	Calhim 2006	Lekking	PG	Pitcher 2005; Irestedt et al 2009
Pardalotus_rubricatus	-2.000	Calhim 2006	1.079	Calhim 2006		M	Pitcher 2005
Pardalotus_striatus	-1.699	Calhim 2006	1.053	Calhim 2006		C	Pitcher 2005
Paroaria_coronata	-0.252	Calhim 2006	1.599	Calhim 2006		M	Pitcher 2005
Parotia_lawesii	-0.229	Calhim 2006	2.201	Calhim 2006	Lekking	PG	Pitcher 2005;

							Hoglund 1989; Irestedt et al 2009
Parotia_wahnesi	-0.237	Calhim 2006	2.190	Calhim 2006	Lekking	PG	Pitcher 2005; Hoglund 1989; Irestedt et al 2009
Setophaga_americana	-0.678	Calhim 2006	0.851	Calhim 2006		M	Pitcher 2005
Oreothlypis_gutturalis	-0.824	Calhim 2006	0.978	Calhim 2006		M	Pitcher 2005
Oreothlypis_superciliosa	-1.222	Calhim 2006	0.954	Calhim 2006		M	Pitcher 2005
Poecile_atricapilla	-0.569	Calhim 2006	1.104	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Poecile_carolinensis	-0.658	Calhim 2006	1.037	Calhim 2006		M	Pitcher 2005
Poecile_gambeli	-0.854	Calhim 2006	1.079	Calhim 2006		M	Pitcher 2005
Poecile_hudsonica	-0.770	Calhim 2006	1.045	Calhim 2006		M	Pitcher 2005
Parus_major	-0.886	Hayward 2011	1.279	Hayward 2011		M	Garamszegi 2005; Pitcher 2005; Biagolini 2017
Poecile_montanus	-0.959	Hayward 2011	1.009	Hayward 2011		M	Garamszegi 2005; Pitcher 2005;

							Biagolini 2017
Poecile_sclateri	-0.678	Calhim 2006	1.041	Calhim 2006		M	Pitcher 2005
Passer_domesticus	-0.377	Hayward 2011	1.447	Hayward 2011		M	Pitcher 2005; Biagolini 2017
Passer_hispaniolensis	-0.097	Calhim 2006	1.431	Calhim 2006		M	Pitcher 2005
Passer_montanus	-0.509	Calhim 2006	1.342	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Passerculus_sandwichensis	-0.310	Calhim 2006	1.276	Calhim 2006		PG	Pitcher 2005; Biagolini 2017
Passerella_iliaca	-0.222	Calhim 2006	1.550	Calhim 2006		M	Pitcher 2005
Passerina_caerulea	-0.481	Calhim 2006	1.210	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Passerina_ciris	-0.387	Calhim 2006	1.161	Calhim 2006		PG	Pitcher 2005
Passerina_cyanea	-0.252	Calhim 2006	1.173	Calhim 2006		PG	Pitcher 2005; Biagolini 2017
Passerina_versicolor	-0.854	Calhim 2006	1.461	Calhim 2006		M	Pitcher 2005
Patagioenas_fasciata	0.248	Calhim 2006	2.515	Calhim 2006		M	Pitcher 2005
Patagioenas_leucocephala	0.117	Calhim 2006	2.420	Calhim 2006		M	Pitcher 2005

Patagioenas_speciosa	0.491	Calhim 2006	2.418	Calhim 2006	M	Pitcher 2005
Pavo_cristatus	0.975	Calhim 2006	3.680	Calhim 2006		
Pelagodroma_marina	-0.854	Calhim 2006	1.604	Calhim 2006	M	Pitcher 2005
Pelecanoides_urinatrix	0.580	Calhim 2006	2.043	Calhim 2006	M	Pitcher 2005
Peltops_blainvillii	-1.523	Calhim 2006	1.544	Calhim 2006	M	Pitcher 2005
Penelopina_nigra	0.328	Calhim 2006	2.949	Calhim 2006	PG	Pitcher 2005
Peneothello_cyanus	-0.260	Calhim 2006	1.389	Calhim 2006	C	Pitcher 2005
Peneothello_sigillata	-1.301	Calhim 2006	1.314	Calhim 2006	M	Pitcher 2005
Perdicula_asiatica	-0.036	Calhim 2006	1.903	Calhim 2006	M	Pitcher 2005
Perdix_perdix	-0.244	Hayward 2011	2.602	Hayward 2011	M	Garamszegi 2005
Petrochelidon_pyrrhonota	-0.420	Calhim 2006	1.334	Calhim 2006	M	Pitcher 2005
Petroica_goodenovii	-0.886	Calhim 2006	0.903	Calhim 2006	M	Pitcher 2005; Biagolini 2017
Petroica_multicolor	-0.796	Calhim 2006	1.079	Calhim 2006	M	Pitcher 2005
Petroica_rodinogaster	-0.553	Calhim 2006	0.991	Calhim 2006	M	Pitcher 2005
Petroica_rosea	-0.638	Calhim 2006	0.935	Calhim 2006	M	Pitcher 2005
Pezopetes_capitalis	-0.022	Calhim 2006	1.747	Calhim 2006	M	Pitcher 2005

Phaethornis_superciliosus	-1.222	Calhim 2006	0.699	Calhim 2006	Lekking			Pitcher 2005
Phalacrocorax_aristotelis	0.893	Calhim 2006	3.288	Calhim 2006			M	Pitcher 2005
Phalacrocorax_sulcirostris	0.000	Calhim 2006	3.041	Calhim 2006			M	Pitcher 2005
Phalaropus_fulicaria	0.212	Hayward 2011	1.663	Hayward 2011			PA/PGA	Garamszegi 2005; Griffith 2002; Pitcher 2005; Biagolini 2017
Phalaropus_lobatus	-0.347	Hayward 2011	1.544	Hayward 2011			PA/PGA	Garamszegi 2005; Pitcher 2005; Biagolini 2017
Phaps_chalcoptera	0.322	Calhim 2006	2.494	Calhim 2006			M	Pitcher 2005
Pharomachrus_auriceps	-0.215	Calhim 2006	2.248	Calhim 2006			M	Pitcher 2005
Phasianus_colchicus	0.914	Hayward 2011	3.120	Hayward 2011	Lekking		PG	Pitcher 2005
Pheucticus_ludovicianus	-0.347	Calhim 2006	1.659	Calhim 2006			M	Pitcher 2005
Pheucticus_melanocephalus	-0.201	Calhim 2006	1.643	Calhim 2006			M	Pitcher 2005
Philemon_argenticeps	-1.301	Calhim 2006	1.987	Calhim 2006			M	Pitcher 2005
Philemon_buceroides	-0.301	Calhim 2006	2.201	Calhim 2006			M	Pitcher 2005
Philemon_citreogularis	-0.658	Calhim 2006	1.724	Calhim 2006			C	Pitcher 2005

Philemon_corniculatus	0.057	Calhim 2006	2.049	Calhim 2006		M	Pitcher 2005
Philemon_meyeri	-0.620	Calhim 2006	1.653	Calhim 2006		M	Pitcher 2005
Philomachus_pugnax	0.657	Calhim 2006	2.230	Calhim 2006	Lekking	PG	Pitcher 2005; Beehler 1988; Szekely 2000
Phoenicurus_ochruros	-0.824	Calhim 2006	1.217	Calhim 2006		M	Biagolini 2017
Phoenicurus_phoenicurus	-1.000	Calhim 2006	1.146	Calhim 2006		PG	Pitcher 2005; Biagolini 2017
Phylidonyris_albifrons	-0.602	Hayward 2011	1.262	Hayward 2011		M	Garamszegi 2005
Phylidonyris_melanops	-0.585	Calhim 2006	1.246	Calhim 2006		M	Pitcher 2005
Phylidonyris_novaehollandiae	-0.678	Calhim 2006	1.362	Calhim 2006		C	Pitcher 2005
Phylidonyris_pyrrhoptera	-0.620	Calhim 2006	1.279	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Phylloscopus_collybita	-0.721	Calhim 2006	0.903	Calhim 2006		M	Pitcher 2005
Phylloscopus_fuscatus	-1.114	Calhim 2006	0.982	Calhim 2006		PG	Biagolini 2017
Phylloscopus_sibilatrix	-0.796	Calhim 2006	0.954	Calhim 2006		PG	Pitcher 2005; Biagolini 2017
Phylloscopus_trochilus	-0.745	Calhim 2006	0.954	Calhim 2006		PG	Pitcher 2005;

								Biagolini 2017
Pica_pica	0.097	Calhim 2006	2.342	Calhim 2006			M	Pitcher 2005
Picoides_arcticus	-1.699	Calhim 2006	1.857	Calhim 2006			M	Pitcher 2005
Picoides_pubescens	-1.046	Calhim 2006	1.431	Calhim 2006			M	Pitcher 2005
Picoides_scalaris	-1.398	Calhim 2006	1.481	Calhim 2006			M	Pitcher 2005
Picoides_villosus	-1.398	Calhim 2006	1.845	Calhim 2006			M	Pitcher 2005
Pipilo_chlorurus	-1.097	Calhim 2006	1.468	Calhim 2006			M	Pitcher 2005
Pipilo_crissalis	-0.174	Calhim 2006	1.732	Calhim 2006			M	Pitcher 2005
Pipilo_erythrophthalmus	-0.745	Hayward 2011	1.594	Hayward 2011			M	Garamszegi 2005; Pitcher 2005
Pipilo_fuscus	-0.060	Calhim 2006	1.660	Calhim 2006			M	Pitcher 2005
Pipilo_maculatus	-0.347	Calhim 2006	1.584	Calhim 2006			M	Pitcher 2005; Biagolini 2017
Pipilo_ocai	-0.585	Calhim 2006	1.810	Calhim 2006				
Pipra_erythrocephala	-0.523	Calhim 2006	1.041	Calhim 2006	Lekking		PG	Pitcher 2005; Prum 1994 (Family is polygynous)
Pipra_filicauda	-0.959	Calhim 2006	1.140	Calhim 2006	Lekking		PG	Pitcher 2005; Prum 1994

							(Family is polygynous)
Pipra_mentalis	-1.398	Calhim 2006	1.176	Calhim 2006	Lekking	PG	Pitcher 2005; Prum 1994 (Family is polygynous)
Piranga_bidentata	-0.301	Calhim 2006	1.540	Calhim 2006		M	Pitcher 2005
Piranga_erythrocephala	-0.409	Calhim 2006	1.338	Calhim 2006		M	Pitcher 2005
Piranga_flava	-0.585	Calhim 2006	1.580	Calhim 2006		M	Pitcher 2005
Piranga_ludoviciana	-0.377	Calhim 2006	1.449	Calhim 2006		M	Pitcher 2005
Piranga_olivacea	-0.292	Calhim 2006	1.462	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Piranga_rubra	-0.319	Calhim 2006	1.473	Calhim 2006		M	Pitcher 2005
Pitohui_ferrugineus	0.236	Calhim 2006	1.954	Calhim 2006		C	Pitcher 2005
Pitohui_nigrescens	-0.620	Calhim 2006	1.792	Calhim 2006		M	Pitcher 2005
Platycercus_elegans	-0.432	Calhim 2006	2.127	Calhim 2006		M	Pitcher 2005
Plectorhyncha_lanceolata	-1.301	Calhim 2006	1.602	Calhim 2006			
Plectrophenax_nivalis	0.000	Hayward 2011	1.519	Hayward 2011		M	Garamszegi 2005; Pitcher 2005; Biagolini 2017

Plocepasser_mahali	-0.509	Hayward 2011	1.643	Hayward 2011		C	Biagolini 2017
Ploceus_cucullatus	-0.444	Calhim 2006	1.602	Calhim 2006		PG	Pitcher 2005
Ploceus_philippinus	-0.161	Hayward 2011	1.398	Hayward 2011		PG	Pitcher 2005
Pluvialis_apricaria	-0.201	Calhim 2006	2.267	Calhim 2006		M	Pitcher 2005; Szekely 2000
Pluvialis_dominica	-1.097	Calhim 2006	2.161	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Pluvialis_squatarola	-1.301	Calhim 2006	2.342	Calhim 2006		M	Pitcher 2005
Podargus_strigoides	-0.569	Calhim 2006	2.448	Calhim 2006		M	Pitcher 2005
Podiceps_nigricollis	-0.721	Calhim 2006	2.465	Calhim 2006		M	Pitcher 2005
Podilymbus_podiceps	-0.036	Calhim 2006	2.649	Calhim 2006		M	Pitcher 2005
Poecilodryas_superciliosa	-0.959	Calhim 2006	1.301	Calhim 2006		M	Pitcher 2005
Poephila_cincta	-0.824	Calhim 2006	1.218	Calhim 2006		M	Pitcher 2005
Polioptila_caerulea	-1.222	Calhim 2006	0.778	Calhim 2006		M	Pitcher 2005
Polioptila_melanura	-1.301	Calhim 2006	0.708	Calhim 2006		M	Pitcher 2005
Pomatostomus_halli	-0.959	Calhim 2006	1.613	Calhim 2006		C	Pitcher 2005
Pomatostomus_ruficeps	-0.745	Hayward 2011	1.701	Hayward 2011		C	Pitcher 2005
Pomatostomus_superciliosus	-0.745	Hayward 2011	1.623	Hayward 2011		C	Pitcher 2005

Pomatostomus_temporalis	-0.268	Calhim 2006	2.083	Calhim 2006	C	Pitcher 2005; Biagolini 2017
Pooecetes_gramineus	-0.222	Hayward 2011	1.431	Hayward 2011	M	Garamszegi 2005; Pitcher 2005
Porphyrio_porphyrio	0.865	Calhim 2006	2.826	Calhim 2006	C	Griffith 2002; Pitcher 2005; Biagolini 2017
Progne_chalybea	-0.004	Calhim 2006	1.623	Calhim 2006	M	Pitcher 2005
Progne_subis	-0.328	Calhim 2006	1.708	Calhim 2006	PG	Pitcher 2005; Biagolini 2017
Progne_tapera	-0.387	Calhim 2006	1.549	Calhim 2006	M	Pitcher 2005
Prosthemadera_novaeseelandiae	0.161	Calhim 2006	2.097	Calhim 2006	M	Biagolini 2017
Protonotaria_citrea	-0.921	Calhim 2006	1.124	Calhim 2006	M	Pitcher 2005
Prunella_collaris	0.483	Calhim 2006	1.673	Calhim 2006	PA/PGA	Griffith 2002; Biagolini 2017
Prunella_modularis	-0.161	Calhim 2006	1.318	Calhim 2006	PA/PGA	Griffith 2002; Pitcher 2005; Biagolini 2017
Psarocolius_decumanus	-0.143	Calhim 2006	2.484	Calhim 2006	PG	Pitcher 2005

Psarocolius_montezuma	-1.301	Calhim 2006	2.603	Calhim 2006			PG	Pitcher 2005
Psarocolius_wagleri	0.204	Calhim 2006	2.313	Calhim 2006			PG	Pitcher 2005
Psephotus_haematonotus	-0.602	Calhim 2006	1.813	Calhim 2006			M	Pitcher 2005
Psittacula_krameri	-0.357	Hayward 2011	2.107	Hayward 2011			M	Garamszegi 2005
Psophodes_olivaceus	-0.276	Calhim 2006	1.778	Calhim 2006			M	Pitcher 2005
Pteridophora_alberti	-0.036	Calhim 2006	1.949	Calhim 2006	Lekking		PG	Pitcher 2005; Irestedt et al 2009
Ptilinopus_magnificus	0.294	Calhim 2006	2.681	Calhim 2006			M	Pitcher 2005
Ptilinopus_regina	-0.553	Calhim 2006	2.041	Calhim 2006			M	Pitcher 2005
Ptilinopus_superbus	0.155	Calhim 2006	2.101	Calhim 2006			M	Pitcher 2005
Ptilonorhynchus_violaceus	-0.959	Hayward 2011	2.238	Hayward 2011	Lekking		PG	Garamszegi 2005; Pitcher 2005; Lenz 1994
Ptiloprora_guisei	-0.770	Calhim 2006	1.322	Calhim 2006			M	Pitcher 2005
Ptiloris_magnificus	0.212	Calhim 2006	2.260	Calhim 2006	Lekking		PG	Pitcher 2005; Irestedt et al 2009
Ptilorrhoa_caerulescens	-1.046	Calhim 2006	1.740	Calhim 2006			M	Pitcher 2005
Puffinus_tenuirostris	0.146	Calhim 2006	2.748	Calhim 2006			M	Pitcher 2005; Biagolini 2017

Pycnonotus_barbatus	-0.215	Calhim 2006	1.587	Calhim 2006	M	Pitcher 2005
Pycnoptilus_floccosus	-1.046	Calhim 2006	1.491	Calhim 2006	M	Pitcher 2005
Pycnopygius_cinereus	-0.367	Calhim 2006	1.690	Calhim 2006	M	Pitcher 2005
Pygochelidon_cyanoleuca	-0.699	Calhim 2006	1.033	Calhim 2006	M	Pitcher 2005
Pygoscelis_adeliae	1.292	Hayward 2011	3.699	Hayward 2011	M	Garamszegi 2005; Pitcher 2005; Biagolini 2017
Pygoscelis_papua	1.292	Hayward 2011	3.792	Hayward 2011	M	Garamszegi 2005; Pitcher 2005
Pyrocephalus_rubinus	-0.638	Calhim 2006	1.149	Calhim 2006	M	Pitcher 2005; Biagolini 2017
Pyrrholaemus_brunneus	-1.097	Calhim 2006	1.041	Calhim 2006	M	Pitcher 2005
Pyrrhula_pyrrhula	-1.284	Calhim 2006	1.290	Calhim 2006		
Quelea_quelea	-0.523	Calhim 2006	1.228	Calhim 2006	M	Biagolini 2017
Quiscalus_major	0.305	Calhim 2006	2.292	Calhim 2006	PG	Pitcher 2005
Quiscalus_mexicanus	0.508	Calhim 2006	2.345	Calhim 2006	PG	Pitcher 2005
Quiscalus_quiscula	0.220	Calhim 2006	2.092	Calhim 2006	M	Pitcher 2005
Rallus_elegans	-0.143	Calhim 2006	2.618	Calhim 2006	M	Pitcher 2005

Rallus_limicola	-0.284	Calhim 2006	1.949	Calhim 2006		M	Pitcher 2005
Ramphocaenus_melanurus	-0.745	Calhim 2006	1.017	Calhim 2006		M	Pitcher 2005
Ramphocelus_passerinii	-0.137	Calhim 2006	1.504	Calhim 2006		M	Pitcher 2005
Regulus_calendula	-0.921	Calhim 2006	0.839	Calhim 2006		M	Pitcher 2005
Regulus_satrapa	-0.854	Calhim 2006	0.771	Calhim 2006		M	Pitcher 2005
Rhipidura_albolimbata	-1.046	Calhim 2006	0.929	Calhim 2006		M	Pitcher 2005
Rhipidura_atra	-0.959	Calhim 2006	1.033	Calhim 2006		M	Pitcher 2005
Rhipidura_brachyrhyncha	-0.658	Calhim 2006	0.903	Calhim 2006		M	Pitcher 2005
Rhipidura_fuliginosa	-0.398	Calhim 2006	0.968	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Rhipidura_hyperythra	-1.046	Calhim 2006	1.041	Calhim 2006		M	Pitcher 2005
Rhipidura_leucophrys	-0.131	Calhim 2006	1.301	Calhim 2006		M	Pitcher 2005
Rhipidura_leucothorax	-0.456	Calhim 2006	1.352	Calhim 2006		M	Pitcher 2005
Rhipidura_rufidorsa	-0.620	Calhim 2006	0.699	Calhim 2006		M	Pitcher 2005
Rhipidura_rufiventris	-0.137	Calhim 2006	1.161	Calhim 2006		M	Pitcher 2005
Rhipidura_threnothorax	-1.523	Calhim 2006	1.230	Calhim 2006		M	Pitcher 2005
Riparia_riparia	-0.620	Calhim 2006	1.146	Calhim 2006		M	Pitcher 2005; Biagolini 2017

Rissa_tridactyla	-0.155	Calhim 2006	2.591	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Rostratula_benghalensis	0.513	Calhim 2006	2.097	Calhim 2006		PA/PGA	Pitcher 2005; Szekely 2000
Rupicola_peruviana	-0.018	Calhim 2006	2.452	Calhim 2006	Lekking		Pitcher 2005
Saltator_maximus	-0.337	Calhim 2006	1.672	Calhim 2006		M	Pitcher 2005
Sappho_sparganura	-1.699	Calhim 2006	0.740	Calhim 2006		PG	Pitcher 2005
Saxicola_caprata	-1.222	Calhim 2006	1.250	Calhim 2006		M	Pitcher 2005
Saxicola_rubetra	-0.921	Calhim 2006	1.220	Calhim 2006			
Saxicola_torquata	-0.523	Hayward 2011	1.204	Hayward 2011		M	Garamszegi 2005; Pitcher 2005
Sayornis_nigricans	-1.398	Calhim 2006	1.290	Calhim 2006		M	Pitcher 2005
Sayornis_saya	-0.658	Calhim 2006	1.326	Calhim 2006		M	Pitcher 2005
Schoeniophylax_phryganophilus	-0.509	Calhim 2006	1.276	Calhim 2006		M	Pitcher 2005
Scolopax_minor	-0.060	Calhim 2006	2.188	Calhim 2006	Lekking	PG	Pitcher 2005; Szekely 2000
Seiurus_aurocapilla	-0.699	Calhim 2006	1.276	Calhim 2006		M	Pitcher 2005
Sericornis_citreogularis	-0.824	Calhim 2006	1.176	Calhim 2006		M	Pitcher 2005

Sericornis_frontalis	-0.432	Calhim 2006	1.041	Calhim 2006		C	Griffith 2002; Pitcher 2005; Biagolini 2017
Sericornis_magnirostris	-0.398	Calhim 2006	1.000	Calhim 2006		C	Pitcher 2005
Sericornis_nouhuysi	-0.276	Calhim 2006	1.114	Calhim 2006		C	Pitcher 2005
Sericornis_papuensis	-1.155	Calhim 2006	0.929	Calhim 2006		M	Pitcher 2005
Sericornis_perspicillatus	-0.569	Calhim 2006	0.778	Calhim 2006		C	Pitcher 2005
Sericulus_chrysocephalus	-0.086	Calhim 2006	1.869	Calhim 2006	Lekking	PG	Pitcher 2005; Lenz 1994
Serinus_canaria	-0.638	Hayward 2011	1.114	Hayward 2011		M	Garamszegi 2005; Pitcher 2005; Biagolini 2017
Serinus_serinus	-0.824	Calhim 2006	1.049	Calhim 2006		M	Biagolini 2017
Setophaga_ruticilla	-0.553	Calhim 2006	0.935	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Sialia_currucoides	-0.180	Calhim 2006	1.471	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Sialia_mexicana	-0.699	Calhim 2006	1.462	Calhim 2006		C	Griffith 2002; Biagolini 2017

Sialia_sialis	-0.577	Calhim 2006	1.491	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Sicalis_flaveola	-0.444	Calhim 2006	1.320	Calhim 2006			
Sitta_canadensis	-0.959	Calhim 2006	0.991	Calhim 2006		M	Pitcher 2005
Sitta_carolinensis	-1.000	Calhim 2006	1.324	Calhim 2006		M	Pitcher 2005
Sitta_pusilla	-0.886	Calhim 2006	1.004	Calhim 2006		C	Pitcher 2005; Biagolini 2017
Sitta_pygmaea	-1.523	Calhim 2006	1.025	Calhim 2006		C	Pitcher 2005
Smicrornis_brevirostris	-1.301	Calhim 2006	0.708	Calhim 2006		C	Pitcher 2005
Somateria_mollissima	0.732	Calhim 2006	3.325	Calhim 2006		M	Pitcher 2005
Spheniscus_magellanicus	0.922	Hayward 2011	3.650	Hayward 2011		M	Garamszegi 2005
Sphyrapicus_varius	-1.046	Calhim 2006	1.677	Calhim 2006		M	Pitcher 2005
Spiza_americana	-0.187	Calhim 2006	1.447	Calhim 2006		PG	Pitcher 2005; Biagolini 2017
Spizella_arborea	-0.538	Hayward 2011	1.305	Hayward 2011		M	Garamszegi 2005; Pitcher 2005
Spizella_atrogularis	-1.000	Calhim 2006	1.083	Calhim 2006		M	Pitcher 2005
Spizella_breweri	-0.678	Calhim 2006	1.037	Calhim 2006		M	Pitcher 2005

Spizella_pallida	-0.699	Calhim 2006	1.041	Calhim 2006		M	Pitcher 2005
Spizella_passerina	-0.745	Calhim 2006	1.093	Calhim 2006		PG	Pitcher 2005
Spizella_pusilla	-0.796	Calhim 2006	1.121	Calhim 2006		PG	Pitcher 2005
Stagonopleura_guttata	-1.046	Calhim 2006	1.176	Calhim 2006		M	Pitcher 2005
Phalaropus_tricolor	-0.114	Hayward 2011	1.714	Hayward 2011		PA/PGA	Garamszegi 2005; Pitcher 2005; Biagolini 2017
Stercorarius_longicaudus	-0.770	Calhim 2006	2.447	Calhim 2006		M	Pitcher 2005
Stercorarius_parasiticus	0.544	Calhim 2006	2.642	Calhim 2006		M	Pitcher 2005
Stercorarius_pomarinus	0.013	Calhim 2006	2.812	Calhim 2006		M	Pitcher 2005
Sterna_forsteri	-0.921	Calhim 2006	2.199	Calhim 2006		M	Pitcher 2005
Sterna_hirundo	-1.046	Calhim 2006	2.079	Calhim 2006		M	Pitcher 2005; Biagolini 2017; Szekely 2000
Sterna_paradisaea	-0.959	Calhim 2006	2.041	Calhim 2006		M	Pitcher 2005
Streptopelia_chinensis	-0.187	Calhim 2006	2.185	Calhim 2006; Dunn 2001		M	Pitcher 2005

Streptopelia_senegalensis	-0.041	Calhim 2006	2.000	Dunn 2001	Body size incorrect in original source (Peter Dunn, personal communication)	M	Pitcher 2005
Stiltia_isabella	-0.745	Calhim 2006	1.813	Calhim 2006		M	Pitcher 2005; Szekely 2000
Streptopelia_decaocto	-0.086	Hayward 2011	2.161	Hayward 2011		M	Garamszegi 2005; Pitcher 2005
Streptopelia_roseogrisea	-0.155	Hayward 2011	2.053	Hayward 2011		M	Garamszegi 2005
Cypseloides_rutilus	-0.229	Calhim 2006	2.025	Calhim 2006		M	Pitcher 2005
Strix_aluco	0.505	Calhim 2006	2.623	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Strix_nebulosa	0.565	Calhim 2006	2.878	Calhim 2006		M	Pitcher 2005
Strix_uralensis	0.398	Calhim 2006	2.794	Calhim 2006		M	Pitcher 2005
Ciccaba_virgata	-0.432	Calhim 2006	2.398	Calhim 2006		M	Pitcher 2005
Struthidea_cinerea	-0.125	Calhim 2006	2.107	Calhim 2006		C	Pitcher 2005
Struthio_camelus	2.062	Hayward 2011	5.000	Hayward 2011		PG	Pitcher 2005
Sturnella_magna	0.025	Calhim 2006	1.934	Calhim 2006		PG	Pitcher 2005
Sturnella_militaris	-0.523	Calhim 2006	1.735	Calhim 2006			
Sturnella_neglecta	0.179	Hayward 2011	1.934	Hayward 2011		PG	Pitcher 2005

Sturnus_roseus	-0.409	Calhim 2006	1.906	Calhim 2006		M	Pitcher 2005
Sturnus_vulgaris	-0.347	Hayward 2011	1.928	Hayward 2011		PG	Pitcher 2005; Biagolini 2017
Surnia_ulula	0.204	Calhim 2006	2.519	Calhim 2006		M	Pitcher 2005
Sylvia_atricapilla	-0.097	Calhim 2006	1.230	Calhim 2006		M	Pitcher 2005
Sylvia_communis	-0.357	Calhim 2006	1.176	Calhim 2006		PG	Pitcher 2005
Sylvia_curruca	-0.357	Calhim 2006	1.004	Calhim 2006			
Synthliboramphus_antiquus	-0.658	Calhim 2006	2.314	Calhim 2006		M	Pitcher 2005
Tachybaptus_novaehollandiae	-0.432	Calhim 2006	2.286	Calhim 2006		M	Pitcher 2005
Tachycineta_bicolor	-0.194	Calhim 2006	1.303	Calhim 2006		PG	Pitcher 2005; Biagolini 2017
Taeniopygia_guttata	-1.301	Hayward 2011	1.079	Hayward 2011		M	Garamszegi 2005; Pitcher 2005; Biagolini 2017
Tangara_chilensis	-0.155	Calhim 2006	1.316	Calhim 2006		M	Pitcher 2005
Tangara_lavinia	-0.620	Calhim 2006	1.342	Calhim 2006		M	Pitcher 2005
Tersina_viridis	-0.444	Calhim 2006	1.456	Calhim 2006		M	Pitcher 2005
Lyrurus_tetrix	0.491	Hayward 2011	3.079	Hayward 2011	Lekking	PG	Beehler 1988

Tetrao_urogallus	0.477	Hayward 2011	3.580	Hayward 2011	Lekking	PA/PGA	Pitcher 2005; Beletsky 1995
Thamnophilus_punctatus	-1.523	Calhim 2006	1.348	Calhim 2006		M	Pitcher 2005
Thinocorus_orbignyianus	-0.886	Calhim 2006	2.068	Calhim 2006		M	Pitcher 2005
Thinornis_rubricollis	-1.699	Calhim 2006	1.970	Calhim 2006		M	Pitcher 2005
Thraupis_bonariensis	-0.125	Calhim 2006	1.505	Calhim 2006		M	Pitcher 2005
Thraupis_cyanocephala	-0.770	Calhim 2006	1.544	Calhim 2006		M	Pitcher 2005
Thraupis_episcopus	-0.495	Hayward 2011	1.544	Hayward 2011		M	Garamszegi 2005; Pitcher 2005
Thraupis_sayaca	-0.167	Calhim 2006	1.505	Calhim 2006		M	Pitcher 2005
Thryothorus_ludovicianus	-0.699	Calhim 2006	1.308	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Tiaris_olivaceus	-0.886	Calhim 2006	0.954	Calhim 2006		M	Pitcher 2005
Timeliopsis_fulvigula	-0.721	Calhim 2006	1.204	Calhim 2006		M	Pitcher 2005
Tinamus_major	0.822	Calhim 2006	3.025	Calhim 2006		PA/PGA	Pitcher 2005
Toxorhamphus_novaeguineae	-1.000	Calhim 2006	1.176	Calhim 2006		M	Pitcher 2005
Toxorhamphus_poliopterus	-1.046	Calhim 2006	1.041	Calhim 2006		M	Pitcher 2005
Toxostoma_curvirostre	0.057	Hayward 2011	1.900	Hayward 2011		M	Garamszegi 2005;

								Pitcher 2005
Toxostoma_guttatum	-0.886	Calhim 2006	1.723	Calhim 2006			M	Pitcher 2005
Toxostoma_rufum	-0.180	Calhim 2006	1.838	Calhim 2006			M	Pitcher 2005
Tregellasia_leucops	-0.143	Calhim 2006	1.146	Calhim 2006			C	Pitcher 2005
Trichodere_cockerelli	-1.046	Calhim 2006	1.182	Calhim 2006			M	Pitcher 2005
Trichoglossus_chlorolepidotus	-1.046	Calhim 2006	1.949	Calhim 2006			M	Pitcher 2005
Trichoglossus_haematodus	-0.638	Calhim 2006	2.090	Calhim 2006			M	Pitcher 2005
Tringa_flavipes	-0.602	Calhim 2006	1.908	Calhim 2006			M	Pitcher 2005
Tringa_glareola	-0.252	Calhim 2006	1.606	Calhim 2006			M	Pitcher 2005
Tringa_melanoleuca	-0.585	Calhim 2006	2.233	Calhim 2006			M	Pitcher 2005
Tringa_solitaria	-1.000	Calhim 2006	1.685	Calhim 2006			M	Pitcher 2005
Troglodytes_aedon	-1.071	Calhim 2006	1.045	Calhim 2006			PG	Pitcher 2005; Biagolini 2017
Troglodytes_troglodytes	-0.921	Calhim 2006	0.954	Calhim 2006			PG	Pitcher 2005
Trogon_melanurus	-0.824	Calhim 2006	2.063	Calhim 2006			M	Pitcher 2005
Tryngites_subruficollis	-0.234	Calhim 2006	1.826	Calhim 2006	Lekking		PG	Pitcher 2005; Cartar 1988; Szekely 2000

Turdus_grayi	-0.108	Hayward 2011	1.868	Hayward 2011		M	Garamszegi 2005; Pitcher 2005; Biagolini 2017
Turdus_merula	0.093	Hayward 2011	2.025	Hayward 2011		M	Garamszegi 2005; Pitcher 2005
Turdus_migratorius	-0.108	Calhim 2006	1.873	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Turdus_philomelos	0.167	Calhim 2006	1.863	Calhim 2006		M	Pitcher 2005
Turdus_pilaris	0.479	Calhim 2006	1.996	Calhim 2006		M	Pitcher 2005
Turnix_pyrrhothorax	-0.585	Calhim 2006	1.568	Calhim 2006		PA/PGA	Pitcher 2005
Turnix_suscitator	-0.456	Calhim 2006	2.000	Calhim 2006		PA/PGA	Pitcher 2005
Turnix_sylvatica	-0.469	Calhim 2006	1.653	Calhim 2006		PA/PGA	Pitcher 2005
Tympanuchus_cupido	0.207	Calhim 2006	2.917	Calhim 2006	Lekking		Pitcher 2005
Tympanuchus_phasianellus	0.310	Calhim 2006	2.887	Calhim 2006	Lekking		Pitcher 2005
Tyrannus_crassirostris	-0.076	Calhim 2006	1.748	Calhim 2006		M	Pitcher 2005
Tyrannus_dominicensis	-0.357	Calhim 2006	1.641	Calhim 2006		M	Pitcher 2005
Tyrannus_forficatus	-0.155	Calhim 2006	1.617	Calhim 2006		M	Pitcher 2005; Biagolini 2017

Tyrannus_melancholicus	-0.292	Calhim 2006	1.600	Calhim 2006		M	Pitcher 2005
Tyrannus_savana	-0.398	Calhim 2006	1.481	Calhim 2006		M	Pitcher 2005
Tyrannus_tyrannus	-0.420	Calhim 2006	1.611	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Tyrannus_vociferans	-0.071	Calhim 2006	1.659	Calhim 2006		M	Pitcher 2005
Tyto_alba	-0.523	Calhim 2006	2.533	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Uria_aalge	0.929	Calhim 2006	2.961	Calhim 2006		M	Pitcher 2005; Biagolini 2017; Szekely 2000
Uria_lomvia	0.903	Calhim 2006	2.978	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Uropsalis_segmentata	0.061	Calhim 2006	1.604	Calhim 2006		M	Pitcher 2005
Oreothlypis_celata	-0.745	Calhim 2006	0.954	Calhim 2006		M	Pitcher 2005
Vermivora_chrysoptera	-0.921	Calhim 2006	0.939	Calhim 2006		M	Pitcher 2005
Oreothlypis_luciae	-0.921	Calhim 2006	0.819	Calhim 2006		M	Pitcher 2005
Oreothlypis_peregrina	-1.000	Calhim 2006	1.009	Calhim 2006		M	Pitcher 2005
Oreothlypis_ruficapilla	-0.921	Calhim 2006	0.949	Calhim 2006		M	Pitcher 2005

Oreothlypis_virginiae	-0.301	Calhim 2006	0.940	Calhim 2006		M	Pitcher 2005
Vidua_paradisaea	-1.046	Calhim 2006	1.279	Calhim 2006	Lekking		Pitcher 2005
Vireo_altiloquus	-0.602	Calhim 2006	1.253	Calhim 2006		M	Pitcher 2005
Vireo_atricapilla	-0.959	Calhim 2006	0.929	Calhim 2006		M	Pitcher 2005
Vireo_bellii	-0.959	Calhim 2006	0.929	Calhim 2006		M	Pitcher 2005
Vireo_flavifrons	-0.854	Calhim 2006	1.255	Calhim 2006		M	Pitcher 2005
Vireo_gilvus	-1.046	Calhim 2006	1.121	Calhim 2006		M	Pitcher 2005
Vireo_griseus	-0.796	Calhim 2006	1.053	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Vireo_huttoni	-1.301	Calhim 2006	1.064	Calhim 2006		M	Pitcher 2005
Vireo_latimeri	-2.000	Calhim 2006	1.049	Calhim 2006		M	Pitcher 2005
Vireo_olivaceus	-0.387	Calhim 2006	1.233	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Vireo_philadelphicus	-0.886	Calhim 2006	1.086	Calhim 2006		M	Pitcher 2005
Vireo_solitarius	-1.046	Calhim 2006	1.220	Calhim 2006		M	Pitcher 2005; Biagolini 2017
Vireo_vicinior	-1.222	Calhim 2006	1.107	Calhim 2006		M	Pitcher 2005
Setophaga_citrina	-0.367	Calhim 2006	1.025	Calhim 2006		M	Pitcher 2005;

							Biagolini 2017
Cardellina_pusilla	-0.796	Calhim 2006	0.903	Calhim 2006		PG	Pitcher 2005
Xanthocephalus_xanthocephalus	-0.013	Hayward 2011	1.901	Hayward 2011		PG	Pitcher 2005
Xanthotis_flaviventer	-1.398	Calhim 2006	1.518	Calhim 2006		M	Pitcher 2005
Zenaida_asiatica	-0.523	Calhim 2006	2.185	Calhim 2006		M	Pitcher 2005
Zenaida_aurita	-0.276	Calhim 2006	2.201	Calhim 2006		M	Pitcher 2005
Zenaida_macroura	-0.081	Calhim 2006	2.093	Calhim 2006		M	Pitcher 2005
Zonotrichia_albicollis	-0.367	Hayward 2011	1.431	Hayward 2011		M	Garamszegi 2005; Pitcher 2005
Zonotrichia_atricapilla	-0.268	Calhim 2006	1.517	Calhim 2006		M	Pitcher 2005
Zonotrichia_capensis	-0.699	Calhim 2006	1.301	Calhim 2006		M	Garamszegi 2005; Pitcher 2005; Biagolini 2017
Zonotrichia_leucophrys	-0.377	Hayward 2011	1.468	Hayward 2011		PG	Pitcher 2005; Biagolini 2017
Zonotrichia_querula	-0.032	Calhim 2006	1.589	Calhim 2006		M	Pitcher 2005
Zoothera_dauma	-1.000	Calhim 2006	2.049	Calhim 2006		M	Pitcher 2005
Zosterops_lateralis	-0.678	Calhim 2006	1.079	Calhim 2006		M	Pitcher 2005;

							Biagolini 2017
Mammals							
Acerodon_jubatus	0.512	Pitnick 2006	2.714	Pitnick 2006	Original data is for Acerodon_mackloti - taxa included by genus matching.		
Axis_axis	1.129	Anderson 2004	4.735	Anderson 2004	Original data is for Axis_calamianensis - taxa included by genus matching.	PA/PGA	Anderson 2004
Bunomys_andrewsi	-0.390	Breed 2000	2.137	Breed 2000	Original data is for Bunomys_fratrorum - taxa included by genus matching.		
Epomophorus_crypturus	-0.046	Pitnick 2006	1.903	Pitnick 2006	Original data is for Epomophorus_labiatus - taxa included by genus matching.		
Epomops_franqueti	-0.524	Pitnick 2006	2.204	Pitnick 2006	Original data is for Epomops_buettikoferi - taxa included by genus matching.	PG	Hosken 2001
Saccolaimus_flaviventris	-0.240	Pitnick 2006	2.000	Pitnick 2006	Original data is for Saccolaimus_peli - taxa included by genus matching.	M	Hosken 2001; Pitnick 2006
Abeomelomys_sevia	-0.069	Breed 2000	1.716	Breed 2000			
Acinonyx_jubatus	1.041	Iossa 2008	4.640	Iossa 2008		PA/PGA	Iossa 2008; Soulsbury 2010
Acomys_cahirinus	-0.291	Ramm 2005	1.878	Ramm 2005			
Acrobates_pygmaeus	-0.750	Birkhead 1998	1.090	Birkhead 1998		PA/PGA	Pantheria
Addax_nasomaculatus	1.635	Anderson 2004	4.929	Anderson 2004		PA/PGA	Anderson 2004
Aepyceros_melampus	1.461	Anderson 2004	4.760	Anderson 2004		PA/PGA	Anderson 2004;

							Ginsberg 1990
Aepyprymnus_rufescens	0.670	Birkhead 1998	3.380	Birkhead 1998			
Aethomys_chrysophilus	-0.064	Breed 2000	1.929	Breed 2000		M	Lukas 2012; Lukas 2013
Aethomys_ineptus	-0.143	Breed 2000	2.146	Breed 2000			
Ailuropoda_melanoleuca	2.487	Iossa 2008	5.071	Iossa 2008		PA/PGA	Iossa 2008
Akodon_molinae	-0.351	Ramm 2005	1.618	Ramm 2005			
Alcelaphus_buselaphus	2.029	Anderson 2004	5.204	Anderson 2004		PA/PGA	Anderson 2004; Ginsberg 1990
Alces_alces	2.025	Ginsberg 1990	5.897	Ginsberg 1990		PG	Ginsberg 1990; Pantheria; Lukas 2012; Lukas 2013
Allenopithecus_nigroviridis	1.229	Harcourt 1995	3.699	Harcourt 1995			
Alouatta_palliata	1.430	Hayward 2011	3.864	Hayward 2011		PA/PGA	Kenagy 1986; Harcourt 1995
Ammospermophilus_leucurus	0.330	Hayward 2011	1.994	Hayward 2011		PG	Waterman 2007
Ammotragus_lervia	1.275	Anderson 2004	4.833	Anderson 2004		PA/PGA	Anderson 2004
Anisomys_imitator	0.620	Ramm 2007	2.706	Ramm 2007			
Anoura_cultrata	-1.004	Pitnick 2006	1.233	Pitnick 2006			

Anoura_geoffroyi	-1.301	Pitnick 2006	1.179	Pitnick 2006				
Antechinus_flavipes	-0.785	Birkhead 1998	1.697	Birkhead 1998			PA/PGA	Rose 1997; Pantheria
Antechinus_stuartii	-0.456	Hayward 2011	1.591	Hayward 2011			PA/PGA	Pantheria; Rose 1997
Antechinus_swainsonii	-0.441	Birkhead 1998	2.020	Birkhead 1998			PA/PGA	Pantheria; Rose 1997
Antidorcas_marsupialis	1.851	Anderson 2004	4.607	Anderson 2004			PA/PGA	Anderson 2004; Ginsberg 1990
Antilocapra_americana	1.881	Ginsberg 1990	4.790	Ginsberg 1990			PA/PGA	Soulsbury 2010; Ginsberg 1990; Lukas 2013; Lukas 2012
Antrozous_pallidus	-0.770	Ramm 2007	1.346	Ramm 2007				
Aotus_trivirgatus	0.079	Hayward 2011	3.009	Hayward 2011			M	Pantheria; Kenagy 1986; Lukas 2013; Lukas 2012
Apodemus_agrarius	-0.003	Hayward 2011	1.338	Hayward 2011			PA/PGA	Soulsbury 2010
Apodemus_argenteus	-0.207	Hayward 2011	1.322	Hayward 2011				
Apodemus_flavicollis	-0.050	Hayward 2011	1.464	Hayward 2011			PA/PGA	Soulsbury 2010
Apodemus_semotus	0.139	Breed 2000	1.447	Breed 2000				
Apodemus_speciosus	0.091	Breed 2000	1.663	Breed 2000				

Apodemus_sylvaticus	-0.103	Hayward 2011	1.364	Hayward 2011	PA/PGA	Soulsbury 2010; Waterman 2007
Apodemus_uralensis	-0.487	Hayward 2011	1.283	Hayward 2011	PA/PGA	Soulsbury 2010
Arctocephalus_forsteri	1.462	Fitzpatrick 2012	4.999	Fitzpatrick 2012	PG	Pantheria
Arctocephalus_pusillus	1.645	Fitzpatrick 2012	5.097	Fitzpatrick 2012	PG	Pantheria
Arctocephalus_tropicalis	1.462	Fitzpatrick 2012	4.985	Fitzpatrick 2012	PG	Pantheria
Ardops_nichollsi	-1.004	Pitnick 2006	1.228	Pitnick 2006		
Artibeus_jamaicensis	-1.292	Pitnick 2006	1.602	Pitnick 2006	PG	Hosken 2001; Soulsbury 2010
Artibeus_lituratus	-0.640	Pitnick 2006	1.898	Pitnick 2006		
Artibeus_phaeotis	-1.292	Pitnick 2006	1.079	Pitnick 2006		
Arvicola_amphibius	0.326	Hayward 2011	2.432	Hayward 2011		
Atelerix_albiventris	0.369	Anderson 2004	2.716	Anderson 2004	PA/PGA	Anderson 2004
Ateles_fusciceps	0.959	Moller 1988	3.687	Moller 1988	PA/PGA	Moller 1988
Ateles_geoffroyi	1.127	Hayward 2011	3.900	Hayward 2011	PA/PGA	Pantheria; Kenagy 1986; Moller 1988; Harcourt 1995

Avahi_laniger	0.320	Harcourt 1995	3.114	Harcourt 1995		M	Pantheria; Lukas 2013; Lukas 2012; Harcourt 1995
Axis_porcinus	1.694	Anderson 2004	4.712	Anderson 2004		PG	Anderson 2004; Pantheria; Lukas 2012; Lukas 2013
Balaena_mysticetus	5.212	Macleod 2010	7.708	Macleod 2010			
Balaenoptera_acutorostrata	3.944	Dines 2015	7.079	Dines 2015		PA/PGA	Skaugh 2008
Balaenoptera_borealis	4.215	Macleod 2010	7.255	Macleod 2010			
Balaenoptera_edeni	4.301	Macleod 2010	7.255	Macleod 2010			
Balaenoptera_musculus	4.845	Macleod 2010	8.029	Macleod 2010			
Balaenoptera_physalus	3.217	Hayward 2011	7.581	Hayward 2011			
Bandicota_bengalensis	0.327	Breed 2000	2.461	Breed 2000			
Bandicota_indica	0.309	Hayward 2011	2.787	Hayward 2011			
Bandicota_savilei	0.101	Breed 2000	2.438	Breed 2000			
Bathyergus_suillus	0.343	Ramm 2005	2.875	Ramm 2005			
Batomys_salomonseni	0.192	Breed 2000	2.288	Breed 2000			

Berardius_bairdii	4.000	Macleod 2010	7.056	Macleod 2010		
Berylmys_bowersi	1.159	Breed 2000	2.634	Breed 2000		
Bettongia_gaimardi	0.759	Rose 1997	3.226	Rose 1997		
Bettongia_penicillata	0.222	Birkhead 1998	2.941	Birkhead 1998		
Bison_bonasus	2.707	Ginsberg 1990	5.829	Ginsberg 1990	PA/PGA	Ginsberg 1990
Bos_taurus	2.297	Anderson 2004	5.954	Anderson 2004	PG	Anderson 2004; Lazo 1995; Bailey 2003
Brachyphylla_cavernarum	-1.194	Pitnick 2006	1.603	Pitnick 2006		
Budorcas_taxicolor	1.970	Anderson 2004	5.398	Anderson 2004	PA/PGA	Anderson 2004
Bullimus_bagobus	0.611	Breed 2000	2.580	Breed 2000		
Bunomys_chrysocomus	0.547	Breed 2000	2.068	Breed 2000		
Burramys_parvus	-1.429	Birkhead 1998	1.591	Birkhead 1998		
Cacajao_calvus	0.763	Harcourt 1995	3.538	Harcourt 1995	PA/PGA	Harcourt 1995
Callithrix_argentata	0.262	Harcourt 1995	2.556	Harcourt 1995	M	Lukas 2012; Lukas 2013
Callithrix_geoffroyi	-0.260	Anderson 2004	2.580	Anderson 2004	M	Lukas 2013; Lukas 2012
Callithrix_jacchus	0.114	Hayward 2011	2.505	Hayward 2011	M	Kenagy 1986; Lukas

							2013; Lukas 2012
Callithrix_pygmaea	-0.481	Harcourt 1995	2.114	Harcourt 1995		M	Pantheria; Lukas 2012; Lukas 2013
Callorhinus_ursinus	1.803	Hayward 2011	4.462	Hayward 2011		PG	Ferguson 2004
Callospermophilus_lateralis	0.512	Hayward 2011	2.273	Hayward 2011		PA/PGA	Kenagy 1986; Waterman 2007
Callospermophilus_saturatus	0.362	Hayward 2011	2.356	Hayward 2011			
Calomys_musculinus	-0.704	Ramm 2005	1.549	Ramm 2005			
Camelus_dromedarius	2.085	Anderson 2004	5.903	Anderson 2004		PG	Anderson 2004; Nowak 1983
Canis_aureus	1.124	Iossa 2008	4.000	Iossa 2008		M	Iossa 2008; Pantheria; Lukas 2013; Lukas 2012; Ferguson 2004
Canis_latrans	1.188	Soulsbury 2010	4.025	Soulsbury 2010		M	Iossa 2008; Soulsbury 2010; Pantheria; Lukas 2013; Lukas 2012; Ferguson 2004

Canis_lupus	1.437	Iossa 2008	4.516	Iossa 2008	M	Iossa 2008; Pantheria; Lukas 2013; Lukas 2012; Ferguson 2004
Caperea_marginata	3.279	Macleod 2010	6.462	Macleod 2010		
Capra_falconeri	1.321	Anderson 2004	4.580	Anderson 2004	PA/PGA	Anderson 2004
Capra_ibex	1.584	Anderson 2004	4.875	Anderson 2004	PA/PGA	Anderson 2004
Capreolus_capreolus	1.653	Hayward 2011	4.310	Hayward 2011	PG	Soulsbury 2010; Kenagy 1986; Pantheria
Capricornis_crispus	1.806	Ginsberg 1990	5.079	Ginsberg 1990	PA/PGA	Ginsberg 1990; Lukas 2013
Cardioderma_cor	-1.398	Ramm 2007	1.462	Ramm 2007	M	Hosken 2001; Pitnick 2006; Pantheria; Lukas 2013
Carollia_perspicillata	-0.903	Pitnick 2006	1.267	Pitnick 2006	PG	Hosken 2001; Pitnick 2006; Pantheria
Castor_canadensis	0.968	Hayward 2011	4.280	Hayward 2011	M	Soulsbury 2010; Pantheria; Kenagy 1986;

							Lukas 2013; Lukas 2012
Castor_fiber	1.241	Hayward 2011	4.260	Hayward 2011		M	Lukas 2013; Lukas 2012; Waterman 2007
Cavia_aperea	0.572	Soulsbury 2010	2.754	Soulsbury 2010		PG	Soulsbury 2010; Waterman 2007
Cavia_porcellus	0.613	Hayward 2011	2.910	Hayward 2011			
Cebus_apella	0.959	Ramm 2007	3.415	Ramm 2007		PA/PGA	Moller 1988; Harcourt 1995
Centurio_senex	-1.097	Pitnick 2006	1.360	Pitnick 2006			
Cephalophus_silvicultor	1.522	Anderson 2004	4.884	Anderson 2004		PG	Anderson 2004; Pantheria; Lukas 2012; Lukas 2013
Cephalorhynchus_commersonii	3.086	Macleod 2010	4.892	Macleod 2010			
Cephalorhynchus_heavisidii	2.728	Dines 2015	4.872	Dines 2015			
Cephalorhynchus_hectori	2.948	Macleod 2010	4.614	Macleod 2010			
Cercartetus_concinnus	-1.208	Birkhead 1998	1.155	Birkhead 1998			
Cercartetus_nanus	-1.174	Birkhead 1998	1.290	Birkhead 1998			

Cercocebus_atys	1.400	Harcourt 1995	3.939	Harcourt 1995			PA/PGA	Lukas 2013; Harcourt 1995
Cercocebus_torquatus	1.400	Hayward 2011	3.939	Hayward 2011				
Cercopithecus_ascanius	0.477	Harcourt 1995	3.729	Harcourt 1995			PA/PGA	Harcourt 1995
Cervus_elaphus	1.848	Anderson 2004	5.505	Anderson 2004			PA/PGA	Soulsbury 2010; Kenagy 1986
Chaerephon_pumilus	-1.420	Pitnick 2006	1.033	Pitnick 2006			PG	Hosken 2001; Pitnick 2006
Chaetodipus_formosus	-0.678	Hayward 2011	1.294	Hayward 2011			PA/PGA	Waterman 2007
Chalinolobus_gouldii	-2.000	Ramm 2007	1.130	Ramm 2007				
Cheirogaleus_major	0.362	Harcourt 1995	2.531	Harcourt 1995			PG	Pantheria; Lukas 2013; Lukas 2012
Chinchilla_lanigera	0.716	Hayward 2011	2.626	Hayward 2011				
Chiropodomys_gliroides	-0.420	Breed 2000	1.342	Breed 2000				
Chiruromys_vates	0.242	Breed 2000	1.681	Breed 2000				
Chlorocebus_aethiops	1.314	Hayward 2011	3.723	Hayward 2011			PA/PGA	Kenagy 1986; Moller 1988; Harcourt 1995

Chrotopterus_auritus	-0.740	Pitnick 2006	1.964	Pitnick 2006	M	Hosken 2001; Pitnick 2006; Lukas 2013
Chrysocyon_brachyurus	1.103	Iossa 2008	4.498	Iossa 2008	M	Iossa 2008; Pantheria; Lukas 2013
Coendou_prehensilis	0.389	Anderson 2004	3.481	Anderson 2004	PG	Anderson 2004; Lukas 2012; Lukas 2013
Coleura_afra	-1.523	Pitnick 2006	1.000	Pitnick 2006	PG	Hosken 2001; Pitnick 2006
Colobus_guereza	0.474	Harcourt 1995	4.017	Harcourt 1995	PA/PGA	Harcourt 1995
Colobus_polykomos	1.137	Hayward 2011	3.993	Hayward 2011	PA/PGA	Kenagy 1986; Harcourt 1995
Conilurus_penicillatus	0.642	Ramm 2007	2.265	Ramm 2007		
Connochaetes_gnou	2.137	Ginsberg 1990	5.134	Ginsberg 1990	PA/PGA	Ginsberg 1990
Connochaetes_taurinus	2.486	Ginsberg 1990	5.356	Ginsberg 1990	PA/PGA	Ginsberg 1990
Crocidura_russula	-1.398	Soulsbury 2010	1.152	Soulsbury 2010	M	Soulsbury 2010
Crocidura_suaveolens	-1.000	Hayward 2011	0.875	Hayward 2011		
Crocuta_crocuta	0.993	Soulsbury 2010	4.653	Soulsbury 2010	PA/PGA	Iossa 2008; Soulsbury 2010

Cryptomys_hottentotus	-0.237	Soulsbury 2010	2.017	Soulsbury 2010	M	Soulsbury 2010; Pantheria; Lukas 2013; Lukas 2012
Cryptoprocta_ferox	1.047	Anderson 2004	4.029	Anderson 2004	PA/PGA	Ferguson 2004; Iossa 2008
Ctenomys_talarum	-0.500	Hayward 2011	2.127	Hayward 2011	PG	Soulsbury 2010; Waterman 2007
Cuon_alpinus	0.803	Anderson 2004	4.252	Anderson 2004	M	Lukas 2013; Lukas 2012
Cynictis_penicillata	0.297	Soulsbury 2010	2.954	Soulsbury 2010	PG	Iossa 2008; Soulsbury 2010; Lukas 2013; Lukas 2012
Cynomops_abrasus	-0.733	Pitnick 2006	0.903	Pitnick 2006		
Cynomys_ludovicianus	0.602	Soulsbury 2010	3.021	Soulsbury 2010	PG	Soulsbury 2010; Waterman 2007
Cynopterus_brachyotis	-0.921	Ramm 2007	1.498	Ramm 2007		
Cynopterus_sphinx	-0.745	Ramm 2007	1.570	Ramm 2007	PA/PGA	Hosken 2001; Pitnick 2006
Cystophora_cristata	2.034	Fitzpatrick 2012	5.409	Fitzpatrick 2012	M	Lukas 2012; Ferguson 2004

Dactylopsila_trivirgata	-0.602	Birkhead 1998	2.669	Birkhead 1998			
Dama_dama	1.602	Anderson 2004	4.775	Anderson 2004		PA/PGA	Anderson 2004; Ginsberg 1990
Damaliscus_pygargus	2.204	Ginsberg 1990	4.860	Ginsberg 1990		PA/PGA	Ginsberg 1990
Dasykaluta_rosamondae	-0.900	Birkhead 1998	1.548	Birkhead 1998			
Dasymys_incomtus	0.484	Hayward 2011	2.384	Hayward 2011			
Dasyuroides_byrnei	0.140	Birkhead 1998	2.092	Birkhead 1998			
Dasyurus_hallucatus	0.130	Birkhead 1998	2.973	Birkhead 1998			
Dasyurus_viverrinus	0.372	Birkhead 1998	3.183	Birkhead 1998			
Delphinapterus_leucas	3.221	Dines 2015	6.098	Dines 2015			
Delphinus_capensis	3.807	Dines 2015	5.104	Dines 2015			
Delphinus_delphis	3.207	Hayward 2011	4.924	Hayward 2011			
Desmodus_rotundus	-1.081	Pitnick 2006	1.528	Pitnick 2006		PG	Hosken 2001; Pitnick 2006
Dicrostonyx_groenlandicus	-0.860	Hayward 2011	1.792	Hayward 2011			
Didelphis_albiventris	0.246	Birkhead 1998	3.111	Birkhead 1998			
Didelphis_virginiana	0.477	Anderson 2004	3.574	Anderson 2004		PG	Anderson 2004; Lukas

						2012; Lukas 2013
Dipodomys_merriami	-0.347	Hayward 2011	1.587	Hayward 2011	PA/PGA	Waterman 2007
Dipodomys_microps	-0.398	Hayward 2011	1.789	Hayward 2011		
Dipodomys_ordii	-0.276	Hayward 2011	1.751	Hayward 2011		
Dipodomys_panamintinus	-0.284	Hayward 2011	1.883	Hayward 2011		
Ectophylla_alba	-1.102	Pitnick 2006	0.740	Pitnick 2006	PG	Hosken 2001
Eidolon_helvum	0.452	Ramm 2007	2.413	Ramm 2007	PA/PGA	Hosken 2001
Elaphurus_davidianus	1.759	Anderson 2004	5.330	Anderson 2004	PA/PGA	Anderson 2004
Elephas_maximus	3.458	Anderson 2004	6.658	Anderson 2004	PA/PGA	Anderson 2004; Ginsberg 1990; Rasmussen 1998
Eonycteris_spelaea	-0.398	Ramm 2007	1.792	Ramm 2007	PG	Hosken 2001; Lukas 2013
Eptesicus_furinalis	-1.222	Ramm 2007	0.877	Ramm 2007		
Equus_asinus	2.306	Anderson 2004	5.462	Anderson 2004	PA/PGA	Anderson 2004
Equus_burchellii	2.480	Ginsberg 1990	5.377	Ginsberg 1990	PG	Pantheria; Lukas 2012; Lukas 2013
Equus_caballus	2.531	Anderson 2004	5.398	Anderson 2004	PA/PGA	Linklater 1999; Anderson 2004;

							Ginsberg 1990
Equus_grevyi	3.061	Ginsberg 1990	5.587	Ginsberg 1990		PA/PGA	Ginsberg 1990
Equus_kiang	2.210	Anderson 2004	5.544	Anderson 2004		PG	Anderson 2004; Lukas 2012; Lukas 2013
Equus_zebra	2.146	Anderson 2004	5.536	Anderson 2004		PG	Anderson 2004; Lukas 2013; Lukas 2012; Ginsberg 1990
Erignathus_barbatus	2.109	Fitzpatrick 2012	5.431	Fitzpatrick 2012		PA/PGA	Ferguson 2004
Erinaceus_europaeus	0.494	Anderson 2004	2.845	Anderson 2004		PA/PGA	Anderson 2004; Soulsbury 2010
Erythrocebus_patas	0.857	Ramm 2007	4.000	Ramm 2007		PA/PGA	Moller 1988; Harcourt 1995
Eschrichtius_robustus	4.829	Macleod 2010	7.398	Macleod 2010			
Eubalaena_japonica	5.988	Dines 2015	7.895	Dines 2015			
Euderma_maculatum	-1.180	Pitnick 2006	1.176	Pitnick 2006			
Eudorcas_rufifrons	0.898	Anderson 2004	4.428	Anderson 2004		PA/PGA	Anderson 2004
Eulemur_fulvus	0.891	Soulsbury 2010	3.398	Soulsbury 2010		PG	Soulsbury 2010;

							Ostner 1999
Eulemur_macaco	1.221	Harcourt 1995	3.398	Harcourt 1995		PA/PGA	Harcourt 1995
Eumetopias_jubatus	2.250	Ramm 2007	5.986	Ramm 2007		PG	Ferguson 2004
Felis_catus	0.558	Soulsbury 2010	3.679	Soulsbury 2010		PG	Iossa 2008; Soulsbury 2010
Felis_chaus	0.665	Iossa 2008	3.907	Iossa 2008			
Felis_nigripes	0.325	Iossa 2008	3.297	Iossa 2008		PG	Iossa 2008
Felis_silvestris	0.438	Anderson 2004	3.438	Anderson 2004		PA/PGA	Anderson 2004; Iossa 2008; Ferguson 2004
Feresa_attenuata	2.877	Dines 2015	5.356	Dines 2015			
Funambulus_palmarum	0.354	Hayward 2011	2.157	Hayward 2011			
Galago_alleni	0.210	Anderson 2004	2.497	Anderson 2004		PA/PGA	Anderson 2004
Galago_senegalensis	0.220	Anderson 2004	2.322	Anderson 2004		PA/PGA	Anderson 2004
Galagoides_demidoff	-0.009	Anderson 2004	1.908	Anderson 2004		PA/PGA	Anderson 2004
Galidia_elegans	0.229	Iossa 2008	2.997	Iossa 2008		M	Iossa 2008; Pantheria; Lukas 2013; Lukas 2012
Gazella_cuvieri	1.595	Anderson 2004	4.423	Anderson 2004		PG	Anderson 2004; Alados 1994

Gazella_dorcas	1.498	Anderson 2004	4.165	Anderson 2004		PG	Anderson 2004; Lukas 2012; Lukas 2013; Pantheria
Gazella_leptoceros	0.823	Anderson 2004	4.061	Anderson 2004		PA/PGA	Anderson 2004
Gazella_subgutturosa	0.916	Anderson 2004	4.398	Anderson 2004		PA/PGA	Anderson 2004
Genetta_genetta	-0.018	Iossa 2008	3.276	Iossa 2008		PA/PGA	Iossa 2008; Ferguson 2004; Lukas 2013; Lukas 2012
Gerbilliscus_afra	0.889	Hayward 2011	1.964	Hayward 2011			
Gerbilliscus_brantsii	0.725	Hayward 2011	1.973	Hayward 2011			
Giraffa_camelopardalis	2.362	Anderson 2004	5.953	Anderson 2004		PA/PGA	Anderson 2004; Ginsberg 1990
Globicephala_macrorhynchus	4.158	Dines 2015	6.556	Dines 2015			
Globicephala_melas	3.699	Hayward 2011	6.289	Hayward 2011			
Glossophaga_leachii	-1.538	Pitnick 2006	0.924	Pitnick 2006			
Glossophaga_morenoi	-2.000	Hosken 2001	0.924	Hosken 2001			
Gorilla_beringei	1.556	Soulsbury 2010	5.301	Soulsbury 2010		PA/PGA	Soulsbury 2010; Lukas 2013

Gorilla_gorilla	1.365	Hayward 2011	5.127	Hayward 2011		PG	Pantheria; Kenagy 1986; Moller 1988; Harcourt 1995
Grammomys_macmillani	-0.179	Breed 2000	1.602	Breed 2000			
Grampus_griseus	4.104	Dines 2015	5.699	Dines 2015			
Gulo_gulo	1.230	Soulsbury 2010	4.161	Soulsbury 2010		PA/PGA	Iossa 2008; Soulsbury 2010; Pantheria; Ferguson 2004
Gymnobelideus_leadbeateri	-0.951	Birkhead 1998	2.063	Birkhead 1998		PG	Lukas 2012; Lukas 2013; Rose 1997
Halichoerus_grypus	2.204	Fitzpatrick 2012	5.399	Fitzpatrick 2012		PG	Lukas 2012; Ferguson 2004; Pantheria
Haplonycteris_fischeri	-0.092	Pitnick 2006	1.255	Pitnick 2006			
Helogale_parvula	-0.347	Anderson 2004	2.658	Anderson 2004		M	Lukas 2013; Lukas 2012; Pantheria; Allaine 2000
Hemitragus_jemlahicus	1.427	Anderson 2004	4.881	Anderson 2004		PA/PGA	Anderson 2004

Herpailurus_yaguarondi	0.519	Iossa 2008	3.771	Iossa 2008		PG	Iossa 2008
Herpestes_javanicus	0.593	Iossa 2008	2.841	Iossa 2008		PA/PGA	Iossa 2008
Heterohyrax_brucei	1.114	Hayward 2011	3.176	Hayward 2011		PG	Pantheria
Hippopotamus_amphibius	2.813	Ginsberg 1990	6.204	Ginsberg 1990		PG	Pantheria; Lukas 2012; Lukas 2013
Hipposideros_galeritus	-0.523	Ramm 2007	0.813	Ramm 2007		M	Hosken 2001; Pitnick 2006; Lukas 2013
Hipposideros_speoris	-1.398	Ramm 2007	1.000	Ramm 2007			
Homo_sapiens	1.701	Anderson 2004	4.803	Anderson 2004		PG	Anderson 2004; Kenagy 1986; Moller 1988; Harcourt 1995
Hyaena_hyaena	0.891	Iossa 2008	4.525	Iossa 2008		PA/PGA	Iossa 2008; Soulsbury 2010
Hydrochoerus_hydrochaeris	1.611	Anderson 2004	4.770	Anderson 2004		PA/PGA	Anderson 2004
Hydromys_chrysogaster	1.071	Ramm 2007	2.872	Ramm 2007			
Hylobates_agilis	0.801	Harcourt 1995	3.778	Harcourt 1995		M	Lukas 2013; Lukas 2012;

							Harcourt 1995
Hylobates_lar	0.740	Hayward 2011	3.740	Hayward 2011		M	Pantheria; Kenagy 1986; Lukas 2013; Lukas 2012; Moller 1988; Harcourt 1995
Hylobates_moloch	0.756	Hayward 2011	3.749	Hayward 2011		M	Kenagy 1986; Lukas 2013; Lukas 2012; Moller 1988; Harcourt 1995
Hylochoerus_meinertzhageni	2.699	Ginsberg 1990	5.305	Ginsberg 1990		PA/PGA	Ginsberg 1990; Lukas 2013
Hyomys_goliath	0.574	Hayward 2011	3.000	Hayward 2011			
Hyperoodon_ampullatus	3.078	Macleod 2010	6.845	Macleod 2010			
Hypsignathus_monstrosus	-0.620	Ramm 2007	2.549	Ramm 2007		PG	Hosken 2001
Hystrix_africaeaustralis	0.823	Ramm 2005	4.072	Ramm 2005		M	Lukas 2013; Lukas 2012; Waterman 2007

Inia_geoffrensis	3.160	Hayward 2011	5.086	Hayward 2011		
Isoodon_macrourus	0.373	Hayward 2011	3.106	Hayward 2011	PG	Nowak 1983
Isoodon_obesulus	0.230	Hayward 2011	3.024	Hayward 2011	PG	Rose 1997; Lukas 2013
Kobus_ellipsiprymnus	1.867	Anderson 2004	5.306	Anderson 2004	PA/PGA	Anderson 2004; Ginsberg 1990
Kobus_kob	1.620	Anderson 2004	5.164	Anderson 2004	PA/PGA	Anderson 2004; Ginsberg 1990
Kobus_leche	1.832	Anderson 2004	5.037	Anderson 2004	PA/PGA	Anderson 2004
Kobus_megaceros	1.716	Anderson 2004	5.015	Anderson 2004	PA/PGA	Anderson 2004
Kogia_breviceps	4.021	Dines 2015	5.657	Dines 2015		
Kogia_sima	3.692	Dines 2015	5.481	Dines 2015		
Lagenorhynchus_acutus	2.521	Macleod 2010	5.301	Macleod 2010		
Lagenorhynchus_obliquidens	3.048	Dines 2015	5.297	Dines 2015		
Lagenorhynchus_obscurus	3.427	Macleod 2010	4.903	Macleod 2010		
Lagothrix_lagotricha	1.049	Hayward 2011	3.718	Hayward 2011	PA/PGA	Pantheria; Kenagy 1986; Lukas 2013; Lukas 2012; Harcourt 1995

Lasiorhinus_latifrons	1.208	Anderson 2004	4.407	Anderson 2004		PA/PGA	Anderson 2004
Lasiurus_ega	-1.699	Ramm 2007	1.077	Ramm 2007			
Lasiurus_seminolus	-1.886	Pitnick 2006	0.968	Pitnick 2006			
Leggadina_forresti	-0.264	Ramm 2007	1.477	Ramm 2007			
Leontopithecus_rosalia	-0.319	Anderson 2004	2.716	Anderson 2004		M	Lukas 2013; Lukas 2012; Harcourt 1995
Leopardus_colocolo	0.489	Iossa 2008	3.525	Iossa 2008		PG	Iossa 2008
Leopardus_geoffroyi	0.782	Iossa 2008	3.681	Iossa 2008		PG	Iossa 2008
Leopardus_pardalis	1.547	Iossa 2008	4.155	Iossa 2008		PA/PGA	Iossa 2008; Ferguson 2004
Leopardus_tigrinus	0.665	Iossa 2008	3.477	Iossa 2008		PG	Iossa 2008; Lukas 2013
Leopardus_wiedii	0.834	Iossa 2008	3.531	Iossa 2008		PG	Iossa 2008
Leopoldamys_sabanus	0.956	Breed 2000	2.572	Breed 2000			
Leporillus_conditor	0.602	Ramm 2007	2.272	Ramm 2007			
Leptomys_elegans	0.093	Ramm 2007	1.839	Ramm 2007			
Leptonycteris_curasoae	-0.580	Pitnick 2006	1.462	Pitnick 2006			
Lepus_americanus	1.072	Soulsbury 2010	3.114	Soulsbury 2010		PA/PGA	Soulsbury 2010

Lepus_timidus	1.222	Hayward 2011	3.421	Hayward 2011		
Lipotes_vexillifer	1.778	Dines 2015	5.097	Dines 2015		
Lissodelphis_borealis	3.189	Dines 2015	5.055	Dines 2015		
Lontra_canadensis	1.255	Iossa 2008	3.792	Iossa 2008	PA/PGA	Iossa 2008; Ferguson 2004
Lophocebus_aterrimus	1.139	Harcourt 1995	4.000	Harcourt 1995	PA/PGA	Lukas 2013; Harcourt 1995
Lophostoma_carrikeri	-0.388	Pitnick 2006	1.362	Pitnick 2006		
Lophuromys_flavopunctatus	0.056	Breed 2000	1.778	Breed 2000		
Lorentzimys_nouhuysi	-0.447	Hayward 2011	1.204	Hayward 2011		
Loris_tardigradus	0.310	Hayward 2011	2.442	Hayward 2011	PA/PGA	Gupta 2007 (and therein)
Loxodonta_africana	3.486	Anderson 2004	6.702	Anderson 2004	PA/PGA	Anderson 2004; Ginsberg 1990; Rasmussen 1998
Lutra_lutra	0.607	Anderson 2004	3.893	Anderson 2004	PG	Anderson 2004; Iossa 2008
Lycalopex_culpaeus	1.274	Iossa 2008	3.957	Iossa 2008	M	Iossa 2008
Lycalopex_griseus	1.049	Iossa 2008	3.398	Iossa 2008	M	Iossa 2008

Lycaon_pictus	1.583	Iossa 2008	4.498	Iossa 2008	PA/PGA	Iossa 2008; Soulsbury 2010; Pantheria; Lukas 2013; Lukas 2012
Lynx_lynx	0.857	Iossa 2008	4.292	Iossa 2008	PA/PGA	Iossa 2008
Lynx_rufus	0.706	Iossa 2008	4.079	Iossa 2008	PA/PGA	Iossa 2008; Ferguson 2004
Macaca_arctoides	1.683	Hayward 2011	4.022	Hayward 2011	PA/PGA	Kenagy 1986; Moller 1988
Macaca_fascicularis	1.547	Anderson 2004	3.653	Anderson 2004	PA/PGA	Soulsbury 2010; Kenagy 1986; Moller 1988
Macaca_fuscata	1.845	Soulsbury 2010	4.090	Soulsbury 2010	PA/PGA	Soulsbury 2010; Moller 1988
Macaca_mulatta	1.690	Anderson 2004	4.049	Anderson 2004	PA/PGA	Kenagy 1986; Moller 1988; Harcourt 1995
Macaca_nemestrina	1.824	Hayward 2011	3.999	Hayward 2011	PA/PGA	Kenagy 1986; Moller 1988
Macaca_radiata	1.760	Hayward 2011	3.924	Hayward 2011	PA/PGA	Kenagy 1986; Moller 1988
Macroderma_gigas	-0.775	Pitnick 2006	2.033	Pitnick 2006		

Macroglossus_minimus	-0.854	Ramm 2007	1.180	Ramm 2007				
Macroglossus_sobrinus	-0.796	Ramm 2007	1.362	Ramm 2007				
Macropus_agilis	1.409	Birkhead 1998	4.057	Birkhead 1998			PA/PGA	Rose 1997; Pantheria
Macropus_eugenii	1.792	Birkhead 1998	3.767	Birkhead 1998			PA/PGA	Rose 1997; Pantheria
Macropus_fuliginosus	1.713	Birkhead 1998	4.533	Birkhead 1998			PA/PGA	Rose 1997; Pantheria
Macropus_giganteus	1.623	Birkhead 1998	4.610	Birkhead 1998			PA/PGA	Pantheria; Rose 1997
Macropus_robustus	1.602	Rose 1997	4.477	Rose 1997			PA/PGA	Rose 1997; Pantheria
Macropus_rufogriseus	1.737	Birkhead 1998	4.267	Birkhead 1998			PA/PGA	Rose 1997; Pantheria
Macropus_rufus	1.582	Birkhead 1998	4.600	Birkhead 1998			PA/PGA	Pantheria
Macrotus_waterhousii	-1.432	Pitnick 2006	1.204	Pitnick 2006				
Madoqua_guentheri	0.498	Anderson 2004	3.512	Anderson 2004			M	Anderson 2004; Lukas 2013
Madoqua_kirkii	0.924	Hayward 2011	3.699	Hayward 2011			M	Soulsbury 2010; Pantheria; Kenagy 1986; Lukas 2013; Lukas 2012
Mallomys_rothschildi	1.157	Hayward 2011	3.036	Hayward 2011				
Mammelomys_lanosus	0.478	Breed 2000	2.090	Breed 2000				

Mandrillus_leucophaeus	1.436	Anderson 2004	4.455	Anderson 2004			PA/PGA	Anderson 2004
Mandrillus_sphinx	1.833	Harcourt 1995	4.544	Harcourt 1995			PG	Harcourt 1995
Marmota_monax	0.869	Hayward 2011	3.620	Hayward 2011			PA/PGA	Kenagy 1986; Waterman 2007
Martes_pennanti	0.916	Hayward 2011	3.724	Hayward 2011			PA/PGA	Iossa 2008; Ferguson 2004
Mastacomys_fuscus	0.571	Ramm 2007	2.068	Ramm 2007				
Mastomys_coucha	-0.130	Breed 2000	1.845	Breed 2000				
Mastomys_natalensis	0.204	Hayward 2011	1.910	Hayward 2011			PA/PGA	Soulsbury 2010
Maxomys_bartelsii	0.624	Breed 2000	1.968	Breed 2000				
Maxomys_surifer	0.522	Breed 2000	2.190	Breed 2000				
Maxomys_whiteheadi	-0.021	Breed 2000	1.806	Breed 2000				
Megaderma_lyra	-1.097	Ramm 2007	1.806	Ramm 2007				
Megaderma_spasma	-0.947	Pitnick 2006	1.354	Pitnick 2006				
Megaptera_novaeangliae	3.091	Hayward 2011	7.502	Hayward 2011			PA/PGA	Pantheria
Meles_meles	1.158	Hayward 2011	4.162	Hayward 2011			PA/PGA	Iossa 2008; Soulsbury 2010; Kenagy 1986

Mellivora_capensis	1.732	Iossa 2008	3.987	Iossa 2008			PA/PGA	Iossa 2008; Ferguson 2004
Melomys_burtoni	0.281	Breed 2000	1.892	Breed 2000				
Melomys_cervinipes	0.444	Breed 2000	2.143	Breed 2000				
Melomys_leucogaster	0.042	Breed 2000	2.017	Breed 2000				
Melomys_rufescens	0.128	Ramm 2007	1.833	Ramm 2007				
Mephitis_mephitis	0.703	Iossa 2008	3.703	Iossa 2008			PG	Iossa 2008; Ferguson 2004
Mesembriomys_gouldii	0.740	Ramm 2007	2.736	Ramm 2007				
Mesembriomys_macrurus	0.918	Breed 2000	2.533	Breed 2000				
Mesocricetus_auratus	0.501	Hayward 2011	2.033	Hayward 2011				
Mesoplodon_carlhubbsi	2.699	Dines 2015	6.176	Dines 2015				
Mesoplodon_europaeus	2.505	Dines 2015	6.079	Dines 2015				
Mesoplodon_ginkgodens	2.447	Dines 2015	6.079	Dines 2015				
Mesoplodon_mirus	2.515	Dines 2015	6.009	Dines 2015				
Mesoplodon_perrini	2.301	Dines 2015	6.079	Dines 2015				
Micaelamys_namaquensis	0.169	Breed 2000	1.857	Breed 2000				
Microcebus_murinus	0.262	Soulsbury 2010	1.855	Soulsbury 2010			PA/PGA	Soulsbury 2010

Micromys_minutus	-0.750	Hayward 2011	0.892	Hayward 2011		
Micropteropus_pusillus	-0.921	Ramm 2007	1.511	Ramm 2007	PG	Hosken 2001
Microtus_agrestis	-0.095	Hayward 2011	1.667	Hayward 2011		
Microtus_arvalis	-0.373	Hayward 2011	1.455	Hayward 2011		
Microtus_californicus	-0.569	Hayward 2011	1.818	Hayward 2011	PG	Lukas 2012; Waterman 2007; Pantheria
Microtus_montanus	-0.420	Ramm 2007	1.633	Ramm 2007	PA/PGA	Lukas 2012; Waterman 2007; Pantheria
Microtus_ochrogaster	-0.056	Soulsbury 2010	1.580	Soulsbury 2010	M	Soulsbury 2010; Pantheria; Lukas 2013; Lukas 2012
Microtus_oeconomus	-0.378	Hayward 2011	1.542	Hayward 2011	PA/PGA	Soulsbury 2010; Waterman 2007
Microtus_pennsylvanicus	0.068	Soulsbury 2010	1.737	Soulsbury 2010	PA/PGA	Soulsbury 2010; Waterman 2007
Microtus_pinetorum	-1.155	Ramm 2007	1.303	Ramm 2007	PA/PGA	Waterman 2007; Lukas 2012; Lukas 2013

Microtus_subterraneus	-0.625	Hayward 2011	1.233	Hayward 2011		
Millardia_meltada	0.033	Breed 2000	1.857	Breed 2000		
Miniopterus_australis	-1.398	Pitnick 2006	0.875	Pitnick 2006	PG	Hosken 2001; Pitnick 2006
Miniopterus_minor	-1.301	Pitnick 2006	0.875	Pitnick 2006	PA/PGA	Hosken 2001; Pitnick 2006
Miniopterus_schreibersii	-1.097	Pitnick 2006	1.114	Pitnick 2006		
Miopithecus_talapoin	0.716	Harcourt 1995	3.097	Harcourt 1995	PA/PGA	Harcourt 1995
Monodelphis_domestica	-0.244	Birkhead 1998	2.041	Birkhead 1998		
Monodon_monoceros	3.082	Dines 2015	6.329	Dines 2015		
Monophyllus_plethodon	-1.377	Pitnick 2006	1.190	Pitnick 2006		
Mops_condylurus	-0.921	Pitnick 2006	1.602	Pitnick 2006		
Mormopterus_planiceps	-1.046	Ramm 2007	0.978	Ramm 2007		
Mungos_mungo	0.246	Anderson 2004	2.176	Anderson 2004	PA/PGA	Anderson 2004; Ferguson 2004
Muntiacus_muntjak	0.813	Anderson 2004	4.243	Anderson 2004	PG	Anderson 2004; Lukas 2012; Lukas 2013
Mus_caroli	-0.967	Hayward 2011	1.176	Hayward 2011		

Mus_minutoides	-1.167	Hayward 2011	0.903	Hayward 2011		M	Lukas 2012
Mus_musculus	-0.924	Hayward 2011	1.185	Hayward 2011		PA/PGA	Soulsbury 2010; Kenagy 1986
Mustela_erminea	0.422	Hayward 2011	2.511	Hayward 2011		PA/PGA	Iossa 2008; Soulsbury 2010; Pantheria; Ferguson 2004
Mustela_eversmannii	0.485	Iossa 2008	3.312	Iossa 2008		PA/PGA	Iossa 2008
Mustela_frenata	0.274	Iossa 2008	2.458	Iossa 2008		PA/PGA	Iossa 2008; Ferguson 2004
Mustela_nigripes	0.473	Iossa 2008	3.009	Iossa 2008		PA/PGA	Iossa 2008; Ferguson 2004
Mustela_nivalis	-0.377	Hayward 2011	2.064	Hayward 2011		PA/PGA	Iossa 2008; Ferguson 2004
Mustela_putorius	0.516	Hayward 2011	3.020	Hayward 2011		PA/PGA	Iossa 2008; Ferguson 2004
Mustela_sibirica	0.220	Iossa 2008	2.620	Iossa 2008		PG	Iossa 2008
Myodes_glareolus	-0.190	Hayward 2011	1.338	Hayward 2011		PA/PGA	Soulsbury 2010; Waterman 2007
Myodes_rufocanus	-0.793	Soulsbury 2010	1.591	Soulsbury 2010		PA/PGA	Soulsbury 2010; Lukas 2013
Myotis_adversus	-0.845	Pitnick 2006	1.000	Pitnick 2006		PA/PGA	Hosken 2001;

							Pitnick 2006
Myotis_albescens	-0.434	Pitnick 2006	0.740	Pitnick 2006		PA/PGA	Hosken 2001; Pitnick 2006
Myotis_bocagii	-1.097	Pitnick 2006	0.903	Pitnick 2006		PG	Hosken 2001; Pitnick 2006
Myotis_evotis	-0.717	Pitnick 2006	0.833	Pitnick 2006			
Myotis_lucifugus	-1.301	Ramm 2007	0.854	Ramm 2007		PA/PGA	Hosken 2001; Pitnick 2006
Myotis_nigricans	-1.585	Pitnick 2006	0.602	Pitnick 2006		PG	Hosken 2001; Pitnick 2006
Naemorhedus_goral	1.562	Anderson 2004	4.439	Anderson 2004		PG	Anderson 2004; Lukas 2012; Lukas 2013; Pantheria
Nanger_dama	1.197	Anderson 2004	4.648	Anderson 2004			
Nasalis_larvatus	1.167	Hayward 2011	4.336	Hayward 2011		PA/PGA	Kenagy 1986; Harcourt 1995
Nasua_nasua	0.714	Iossa 2008	3.751	Iossa 2008		PA/PGA	Iossa 2008; Ferguson 2004
Neofelis_nebulosa	1.480	Anderson 2004	4.398	Anderson 2004		PA/PGA	Ferguson 2004

Neomys_fodiens	-0.678	Hayward 2011	1.301	Hayward 2011		
Neophocaena_phocaenoides	3.248	Macleod 2010	4.856	Macleod 2010		
Neoromicia_nanus	-1.509	Pitnick 2006	0.544	Pitnick 2006	PA/PGA	Hosken 2001; Pitnick 2006
Neotoma_micropus	0.398	Soulsbury 2010	2.423	Soulsbury 2010	PA/PGA	Soulsbury 2010
Neotragus_moschatus	1.770	Anderson 2004	3.813	Anderson 2004	PG	Anderson 2004; Lukas 2012; Lukas 2013
Neovison_vison	0.695	Soulsbury 2010	3.233	Soulsbury 2010	PA/PGA	Iossa 2008; Soulsbury 2010; Ferguson 2004
Niviventer_cremoriventer	0.087	Breed 2000	1.875	Breed 2000		
Niviventer_culturatus	0.273	Breed 2000	2.013	Breed 2000		
Noctilio_albiventris	-1.194	Pitnick 2006	1.494	Pitnick 2006		
Noctilio_leporinus	-0.752	Pitnick 2006	1.812	Pitnick 2006	PG	Hosken 2001; Pitnick 2006
Notomys_alexis	-1.301	Hayward 2011	1.531	Hayward 2011	M	Lukas 2012
Notomys_cervinus	-0.703	Hayward 2011	1.519	Hayward 2011		
Notomys_fuscus	-1.174	Hayward 2011	1.643	Hayward 2011		

Notomys_mitchellii	-1.208	Hayward 2011	1.591	Hayward 2011			
Nyctalus_noctula	-0.569	Ramm 2007	1.455	Ramm 2007		PA/PGA	Hosken 2001; Pitnick 2006
Nyctereutes_procyonoides	0.963	Iossa 2008	3.540	Iossa 2008		M	Iossa 2008; Pantheria; Lukas 2013; Lukas 2012; Ferguson 2004
Nycticebus_coucang	0.079	Anderson 2004	3.024	Anderson 2004		PA/PGA	Anderson 2004
Nyctophilus_geoffroyi	-1.523	Ramm 2007	0.806	Ramm 2007			
Nyctophilus_gouldi	-0.959	Ramm 2007	0.903	Ramm 2007			
Ochotona_curzoniae	0.210	Soulsbury 2010	2.169	Soulsbury 2010		PG	Soulsbury 2010
Odobenus_rosmarus	2.696	Fitzpatrick 2012	5.936	Fitzpatrick 2012		PG	Ferguson 2004
Odocoileus_hemionus	1.939	Hayward 2011	5.050	Hayward 2011		M	Kenagy 1986
Odocoileus_virginianus	1.932	Hayward 2011	4.651	Hayward 2011		PA/PGA	Soulsbury 2010; Kenagy 1986
Okapia_johnstoni	1.856	Anderson 2004	5.398	Anderson 2004		PG	Anderson 2004; Lukas 2012; Lukas 2013
Ondatra_zibethicus	0.704	Hayward 2011	3.112	Hayward 2011		M	Kenagy 1986;

						Lukas 2013; Lukas 2012
Onychomys_torridus	0.170	Hayward 2011	1.307	Hayward 2011		
Orcinus_orca	4.013	Macleod 2010	6.867	Macleod 2010	PA/PGA	Pilot 2009
Ornithorhynchus_anatinus	1.230	Birkhead 1998	3.176	Birkhead 1998		
Oryctolagus_cuniculus	0.741	Anderson 2004	3.279	Anderson 2004	PA/PGA	Anderson 2004; Soulsbury 2010
Oryx_dammah	1.728	Anderson 2004	5.111	Anderson 2004	PA/PGA	Anderson 2004
Oryx_gazella	1.579	Anderson 2004	5.152	Anderson 2004	PG	Anderson 2004; Lukas 2012; Lukas 2013; Pantheria
Oryzomys_palustris	-0.398	Hayward 2011	1.748	Hayward 2011		
Otaria_byronia	1.842	Fitzpatrick 2012	5.477	Fitzpatrick 2012	PG	Pantheria
Otocolobus_manul	0.342	Iossa 2008	3.738	Iossa 2008	PG	Iossa 2008
Otomops_martiensseni	-0.770	Pitnick 2006	1.556	Pitnick 2006	PG	Hosken 2001; Pitnick 2006
Otospermophilus_beecheyi	0.957	Hayward 2011	2.924	Hayward 2011	PG	Soulsbury 2010; Waterman 2007

Ovis_aries	2.504	Hayward 2011	4.544	Hayward 2011			PA/PGA	Soulsbury 2010; Kenagy 1986
Ovis_canadensis	2.529	Anderson 2004	5.076	Anderson 2004			PA/PGA	Anderson 2004; Ginsberg 1990
Ovis_nivicola	1.909	Anderson 2004	4.881	Anderson 2004			PA/PGA	Anderson 2004
Pan_paniscus	2.398	Soulsbury 2010	4.653	Soulsbury 2010			PA/PGA	Soulsbury 2010; Moller 1988
Pan_troglodytes	2.075	Hayward 2011	4.647	Hayward 2011			PA/PGA	Soulsbury 2010; Kenagy 1986; Moller 1988; Harcourt 1995; Pantheria
Panthera_leo	1.740	Soulsbury 2010	5.274	Soulsbury 2010			PA/PGA	Iossa 2008; Soulsbury 2010; Pantheria; Ferguson 2004
Panthera_onca	1.931	Anderson 2004	4.892	Anderson 2004			PA/PGA	Ferguson 2004; Iossa 2008
Panthera_tigris	1.387	Anderson 2004	5.532	Anderson 2004			PA/PGA	Ferguson 2004
Papio_anubis	1.971	Ramm 2007	4.422	Ramm 2007				
Papio_cynocephalus	1.716	Soulsbury 2010	5.386	Soulsbury 2010			PA/PGA	Soulsbury 2010; Moller

									1988; Harcourt 1995
Papio_hamadryas	1.859	Hayward 2011	4.384	Hayward 2011				PG	Kenagy 1986; Harcourt 1995
Papio_papio	1.949	Harcourt 1995	4.505	Harcourt 1995					
Papio_ursinus	1.857	Harcourt 1995	4.502	Harcourt 1995					
Paramelomys_platyops	0.223	Ramm 2007	1.954	Ramm 2007					
Paramelomys_rubex	0.272	Breed 2000	1.699	Breed 2000					
Parastrellus_hesperus	-1.301	Ramm 2007	0.544	Ramm 2007					
Paruromys_dominator	0.204	Breed 2000	2.534	Breed 2000					
Pecari_tajacu	1.053	Hayward 2011	4.090	Hayward 2011				PA/PGA	Ginsberg 1990
Pedetes_capensis	1.261	Ramm 2005	3.509	Ramm 2005				M	Lukas 2012
Peponocephala_electra	3.254	Macleod 2010	5.314	Macleod 2010					
Perameles_nasuta	0.602	Rose 1997	3.000	Rose 1997				PA/PGA	Rose 1997; Lee 1985
Perognathus_longimembris	-1.155	Hayward 2011	0.892	Hayward 2011					
Perognathus_parvus	-0.745	Hayward 2011	1.274	Hayward 2011					
Peromyscus_californicus	-2.018	Soulsbury 2010	1.719	Nelson 1995				M	Soulsbury 2010; Pantheria; Lukas

							2013; Lukas 2012
Peromyscus_leucopus	-0.337	Soulsbury 2010	1.346	Soulsbury 2010		PA/PGA	Soulsbury 2010; Waterman 2007
Peromyscus_maniculatus	-0.406	Hayward 2011	1.290	Hayward 2011		PA/PGA	Soulsbury 2010; Kenagy 1986; Waterman 2007
Petauroides_volans	0.199	Hayward 2011	3.096	Hayward 2011		PG	Pantheria; Lukas 2012; Lukas 2013; Rose 1997
Petaurus_breviceps	-0.699	Birkhead 1998	2.076	Birkhead 1998		PG	Pantheria; Lukas 2012; Lukas 2013; Rose 1997
Petaurus_norfolcensis	-0.790	Birkhead 1998	2.255	Birkhead 1998			
Phacochoerus_aethiopicus	1.968	Anderson 2004	4.863	Anderson 2004		PA/PGA	Anderson 2004; Ginsberg 1990; Somers 1995
Phascolarctos_cinereus	1.175	Anderson 2004	3.674	Anderson 2004		PA/PGA	Anderson 2004; Pantheria
Philander_opossum	0.176	Rose 1997	2.581	Rose 1997			

Phoca_groenlandica	2.107	Fitzpatrick 2012	5.011	Fitzpatrick 2012		PA/PGA	Ferguson 2004
Phoca_vitulina	1.978	Fitzpatrick 2012	4.875	Fitzpatrick 2012		PA/PGA	Ferguson 2004
Phocarctos_hookeri	1.821	Fitzpatrick 2012	5.350	Fitzpatrick 2012		PG	Pantheria
Phocoena_phocoena	3.365	Hayward 2011	4.763	Hayward 2011			
Phocoena_sinus	3.048	Macleod 2010	4.589	Macleod 2010			
Phocoena_spinipinnis	2.692	Macleod 2010	4.786	Macleod 2010			
Phocoenoides_dalli	2.582	Macleod 2010	5.162	Macleod 2010			
Phodopus_sungorus	-0.032	Hayward 2011	1.627	Hayward 2011			
Phyllostomus_discolor	-0.188	Pitnick 2006	1.652	Pitnick 2006		PG	Hosken 2001; Pitnick 2006
Phyllostomus_hastatus	-0.511	Pitnick 2006	1.963	Pitnick 2006		PG	Hosken 2001; Pitnick 2006
Physeter_catodon	4.080	Macleod 2010	7.569	Macleod 2010			
Pipistrellus_kuhlii	-1.301	Ramm 2007	0.765	Ramm 2007			
Pipistrellus_pipistrellus	-0.959	Ramm 2007	0.729	Ramm 2007		PA/PGA	Hosken 2001; Pitnick 2006
Pipistrellus_rusticus	-0.796	Ramm 2007	0.602	Ramm 2007			
Pipistrellus_subflavus	-1.523	Ramm 2007	0.747	Ramm 2007			

Pipistrellus_tenuis	-1.523	Ramm 2007	0.556	Ramm 2007			
Pithecia_pithecia	-0.036	Harcourt 1995	3.204	Harcourt 1995		PA/PGA	Pantheria; Moller 1988; Lukas 2013; Lukas 2012
Platanista_gangetica	3.045	Dines 2015	4.959	Dines 2015			
Plecotus_auritus	-1.046	Ramm 2007	0.890	Ramm 2007		PA/PGA	Hosken 2001; Pitnick 2006
Plecotus_rafinesquii	-0.420	Ramm 2007	0.959	Ramm 2007		PA/PGA	Hosken 2001; Pitnick 2006
Pogonomys_loriae	0.540	Breed 2000	2.021	Breed 2000			
Pogonomys_macrourus	0.391	Breed 2000	1.690	Breed 2000			
Pongo_pygmaeus	1.548	Anderson 2004	5.000	Anderson 2004		PA/PGA	Anderson 2004; Kenagy 1986; Moller 1988
Pontoporia_blainvillei	1.301	Dines 2015	4.618	Dines 2015			
Potorous_tridactylus	0.641	Birkhead 1998	3.107	Birkhead 1998		PA/PGA	Pantheria
Praomys_jacksoni	-0.052	Breed 2000	1.602	Breed 2000			
Presbytis_rubicunda	0.556	Hayward 2011	3.792	Hayward 2011		PG	Pantheria

Prionailurus_viverrinus	1.196	Anderson 2004	4.061	Anderson 2004	PA/PGA	Ferguson 2004; Iossa 2008
Procavia_capensis	1.236	Anderson 2004	3.306	Anderson 2004	PG	Anderson 2004; Lukas 2012; Lukas 2013
Procyon_lotor	1.137	Soulsbury 2010	3.710	Soulsbury 2010	PA/PGA	Iossa 2008; Soulsbury 2010; Pantheria; Ferguson 2004
Proteles_cristatus	1.003	Iossa 2008	4.053	Iossa 2008	M	Iossa 2008; Lukas 2013; Lukas 2012
Przewalskium_albirostris	2.066	Anderson 2004	5.334	Anderson 2004	PA/PGA	Anderson 2004
Pseudantechinus_macdonnellensis	-0.959	Birkhead 1998	1.433	Birkhead 1998		
Pseudocheirus_peregrinus	0.734	Birkhead 1998	2.835	Birkhead 1998	PG	Pantheria; Lukas 2012; Lukas 2013; Rose 1997
Pseudochirops_archeri	0.097	Birkhead 1998	2.679	Birkhead 1998		
Pseudohydromys_ellermani	-0.268	Breed 2000	1.255	Breed 2000		
Pseudomys_apodemoides	-0.851	Hayward 2011	1.491	Hayward 2011		
Pseudomys_australis	0.351	Hayward 2011	1.771	Hayward 2011		

Pseudomys_delicatulus	-1.367	Hayward 2011	0.903	Hayward 2011				
Pseudomys_desertor	-0.253	Hayward 2011	1.591	Hayward 2011				
Pseudomys_fumeus	0.385	Ramm 2007	1.851	Ramm 2007				
Pseudomys_gracilicaudatus	0.035	Hayward 2011	2.021	Hayward 2011				
Pseudomys_hermannsburgensis	-0.788	Hayward 2011	1.255	Hayward 2011				
Pseudomys_nanus	0.273	Hayward 2011	1.892	Hayward 2011				
Pseudomys_novaehollandiae	-1.149	Hayward 2011	1.279	Hayward 2011				
Pseudomys_pilligaensis	-1.284	Breed 2000	1.041	Breed 2000				
Pseudomys_shortridgei	-0.462	Hayward 2011	1.892	Hayward 2011				
Pseudorca_crassidens	4.170	Dines 2015	6.134	Dines 2015				
Pteronotus_davyi	-0.759	Pitnick 2006	0.964	Pitnick 2006				
Pteropus_alecto	0.407	Ramm 2007	2.903	Ramm 2007			PA/PGA	Hosken 2001; Pitnick 2006
Pteropus_giganteus	0.342	Anderson 2004	3.161	Anderson 2004			PA/PGA	Anderson 2004; Hosken 2001
Pteropus_poliocephalus	0.829	Ramm 2007	2.925	Ramm 2007			PA/PGA	Hosken 2001; Pitnick 2006
Pteropus_scapulatus	0.423	Ramm 2007	2.690	Ramm 2007			PA/PGA	Hosken 2001;

						Pitnick 2006
Pteropus_tonganus	0.580	Hayward 2011	3.011	Hayward 2011	PG	Hosken 2001
Puma_concolor	1.173	Soulsbury 2010	4.653	Soulsbury 2010	PA/PGA	Iossa 2008; Soulsbury 2010; Pantheria; Ferguson 2004
Pusa_hispida	1.677	Fitzpatrick 2012	4.839	Fitzpatrick 2012	PG	Smith 1981
Pygathrix_nemaeus	0.924	Anderson 2004	4.269	Anderson 2004	PA/PGA	Anderson 2004
Rangifer_tarandus	1.678	Anderson 2004	5.043	Anderson 2004	PA/PGA	Soulsbury 2010
Rattus_argentiventer	0.484	Breed 2000	2.336	Breed 2000		
Rattus_colletti	0.287	Ramm 2007	2.188	Ramm 2007		
Rattus_exulans	0.415	Hayward 2011	1.778	Hayward 2011		
Rattus_fuscipes	0.630	Ramm 2007	2.041	Ramm 2007	PA/PGA	Waterman 2007
Rattus_hoffmanni	0.373	Breed 2000	2.146	Breed 2000		
Rattus_leucopus	0.618	Breed 2000	2.230	Breed 2000		
Rattus_losea	0.337	Breed 2000	2.041	Breed 2000		
Rattus_lutreolus	0.647	Ramm 2007	2.212	Ramm 2007	PA/PGA	Waterman 2007
Rattus_niobe	0.277	Ramm 2007	1.690	Ramm 2007		

Rattus_norvegicus	0.580	Anderson 2004	2.748	Anderson 2004	PA/PGA	Anderson 2004
Rattus_rattus	0.857	Hayward 2011	2.210	Hayward 2011		
Rattus_sordidus	0.547	Breed 2000	2.199	Breed 2000		
Rattus_steini	0.045	Ramm 2007	1.968	Ramm 2007		
Rattus_tiomanicus	0.541	Breed 2000	1.949	Breed 2000		
Rattus_tunneyi	0.687	Ramm 2007	2.386	Ramm 2007		
Rattus_villosissimus	0.332	Ramm 2007	2.316	Ramm 2007		
Rhabdomys_pumilio	-0.041	Breed 2000	1.740	Breed 2000	M	Lukas 2012
Rhinolophus_clivosus	-0.745	Ramm 2007	1.149	Ramm 2007		
Rhinolophus_hipposideros	-1.699	Ramm 2007	0.640	Ramm 2007		
Rhinolophus_megaphyllus	-0.921	Ramm 2007	0.978	Ramm 2007		
Rhinonicteris_aurantia	-1.921	Pitnick 2006	0.991	Pitnick 2006		
Rhinopoma_hardwickii	-0.886	Ramm 2007	1.279	Ramm 2007		
Rhinopoma_microphyllum	-0.201	Ramm 2007	1.507	Ramm 2007		
Rhogeessa_tumida	-1.114	Pitnick 2006	0.708	Pitnick 2006		
Rhynchonycteris_naso	-2.000	Ramm 2007	0.627	Ramm 2007	PA/PGA	Hosken 2001; Pitnick 2006

Rousettus_aegyptiacus	0.243	Ramm 2007	2.180	Ramm 2007			
Rousettus_amplexicaudatus	-0.432	Ramm 2007	1.921	Ramm 2007			
Rusa_timorensis	1.438	Anderson 2004	4.875	Anderson 2004		PA/PGA	Anderson 2004
Rusa_unicolor	1.889	Anderson 2004	5.303	Anderson 2004		PG	Anderson 2004; Lukas 2013
Saccopteryx_bilineata	-1.959	Pitnick 2006	0.869	Pitnick 2006		PG	Hosken 2001; Pitnick 2006; Soulsbury 2010; Pantheria
Saccopteryx_leptura	-1.602	Pitnick 2006	0.613	Pitnick 2006		M	Pitnick 2006; Pantheria
Saguinus_midas	0.262	Harcourt 1995	2.756	Harcourt 1995		PA/PGA	Pantheria; Lukas 2012; Lukas 2013
Saguinus_nigricollis	0.580	Harcourt 1995	2.672	Harcourt 1995		PA/PGA	Lukas 2012; Lukas 2013; Harcourt 1995; Moller 1988
Saguinus_oedipus	0.170	Hayward 2011	2.700	Hayward 2011		M	Kenagy 1986; Lukas 2013; Lukas 2012
Saimiri_sciureus	0.505	Anderson 2004	2.879	Anderson 2004		PA/PGA	Kenagy 1986; Moller

						1988; Harcourt 1995
Sarcophilus_harrisii	0.716	Anderson 2004	3.795	Anderson 2004	PA/PGA	Anderson 2004; Lukas 2012; Lukas 2013; Gooley 2018
Scalopus_aquaticus	0.342	Hayward 2011	2.097	Hayward 2011		
Sciurus_carolinensis	0.714	Hayward 2011	2.719	Hayward 2011	PA/PGA	Kenagy 1986; Waterman 2007
Sciurus_vulgaris	0.449	Hayward 2011	2.544	Hayward 2011	PG	Waterman 2007
Scotophilus_borbonicus	-0.854	Ramm 2007	1.342	Ramm 2007		
Scotophilus_heathii	-0.770	Ramm 2007	1.574	Ramm 2007	PG	Hosken 2001
Semnopithecus_entellus	1.047	Anderson 2004	4.232	Anderson 2004	PA/PGA	Anderson 2004; Soulsbury 2010; Harcourt 1995
Sigmodon_hispidus	0.238	Hayward 2011	2.348	Hayward 2011		
Sminthopsis_crassicaudata	-0.861	Birkhead 1998	1.190	Birkhead 1998	PG	Rose 1997; Pantheria
Sminthopsis_macroura	-0.608	Birkhead 1998	1.405	Birkhead 1998		
Sminthopsis_virginiae	-0.599	Birkhead 1998	1.491	Birkhead 1998		

Sorex_araneus	-0.553	Hayward 2011	1.124	Hayward 2011	PA/PGA	Soulsbury 2010
Sorex_cinereus	-1.000	Hayward 2011	0.724	Hayward 2011		
Sorex_minutus	-1.000	Hayward 2011	0.708	Hayward 2011		
Sorex_palustris	-0.824	Hayward 2011	1.246	Hayward 2011		
Sotalia_fluviatilis	2.679	Hayward 2011	4.515	Hayward 2011		
Sotalia_guianensis	3.356	Hayward 2011	4.958	Hayward 2011		
Speothos_venaticus	0.916	Iossa 2008	3.869	Iossa 2008	M	Iossa 2008; Lukas 2013; Lukas 2012
Spilogale_gracilis	0.401	Iossa 2008	2.728	Iossa 2008	PA/PGA	Iossa 2008; Ferguson 2004
Spilogale_putorius	0.732	Iossa 2008	2.859	Iossa 2008	PA/PGA	Iossa 2008; Ferguson 2004
Stenella_attenuata	3.012	Hayward 2011	4.906	Hayward 2011		
Stenella_coeruleoalba	2.653	Dines 2015	5.193	Dines 2015		
Stenella_frontalis	3.234	Dines 2015	5.155	Dines 2015		
Stenella_longirostris	3.227	Dines 2015	4.871	Dines 2015	PA/PGA	Perrin 2003
Steno_bredanensis	3.477	Dines 2015	5.190	Dines 2015		
Stenonycteris_lanosus	0.279	Anderson 2004	2.000	Anderson 2004	PA/PGA	Anderson 2004
Sturnira_bidens	-1.237	Pitnick 2006	1.243	Pitnick 2006		

Sturnira_lilium	-0.917	Pitnick 2006	1.310	Pitnick 2006		
Sundamys_muelleri	0.872	Breed 2000	2.602	Breed 2000		
Suricata_suricatta	0.114	Soulsbury 2010	2.864	Soulsbury 2010	M	Iossa 2008; Soulsbury 2010; Pantheria; Lukas 2013; Lukas 2012
Sus_scrofa	2.857	Anderson 2004	5.290	Anderson 2004	PG	Soulsbury 2010; Poteaux 2009
Sylvicapra_grimmia	1.327	Anderson 2004	4.267	Anderson 2004	PG	Anderson 2004; Lukas 2012; Lukas 2013
Sylvilagus_floridanus	1.223	Hayward 2011	3.058	Hayward 2011		
Tachyglossus_aculeatus	1.699	Birkhead 1998	3.699	Birkhead 1998		
Tadarida_aegyptiaca	-1.155	Ramm 2007	1.207	Ramm 2007		
Tadarida_brasiliensis	-1.301	Ramm 2007	1.107	Ramm 2007	PA/PGA	Hosken 2001; Pitnick 2006
Tamias_amoenus	-0.208	Hayward 2011	1.629	Hayward 2011	PA/PGA	Soulsbury 2010; Waterman 2007
Tamias_minimus	-0.143	Hayward 2011	1.502	Hayward 2011		

Tamias_townsendii	-0.086	Hayward 2011	1.833	Hayward 2011		
Tamiasciurus_hudsonicus	0.465	Soulsbury 2010	2.270	Soulsbury 2010	PA/PGA	Soulsbury 2010; Waterman 2007
Taphozous_georgianus	-1.398	Ramm 2007	1.477	Ramm 2007		
Taphozous_longimanus	-1.114	Pitnick 2006	1.556	Pitnick 2006	PG	Hosken 2001; Lukas 2013
Tarsipes_rostratus	-0.438	Birkhead 1998	0.949	Birkhead 1998		
Tasmacetus_shepherdi	3.130	Dines 2015	6.329	Dines 2015		
Tatera_vicina	0.807	Hayward 2011	2.303	Hayward 2011		
Taurotragus_derbianus	2.016	Anderson 2004	5.646	Anderson 2004	PG	Anderson 2004; Lukas 2012; Lukas 2013
Taxidea_taxus	1.551	Iossa 2008	3.895	Iossa 2008	PA/PGA	Iossa 2008; Ferguson 2004
Tenrec_ecaudatus	0.491	Anderson 2004	3.301	Anderson 2004	PA/PGA	Anderson 2004
Theropithecus_gelada	1.332	Hayward 2011	4.310	Hayward 2011	PA/PGA	Kenagy 1986; Moller 1988; Harcourt 1995
Thomomys_bottae	0.551	Hayward 2011	2.279	Hayward 2011	PA/PGA	Kenagy 1986; Waterman 2007

Thylogale_billardierii	1.671	Rose 1997	3.901	Rose 1997		PA/PGA	Rose 1997; Pantheria
Tokudaia_osimensis	-0.672	Hayward 2011	1.949	Hayward 2011			
Trachypithecus_cristatus	0.799	Hayward 2011	3.826	Hayward 2011		PG	Kenagy 1986
Trachypithecus_francoisi	0.600	Anderson 2004	3.881	Anderson 2004		PG	Anderson 2004; Lukas 2012; Lukas 2013
Trachypithecus_obscurus	0.681	Hayward 2011	3.872	Hayward 2011		PG	Kenagy 1986
Tragelaphus_angasii	1.583	Anderson 2004	4.971	Anderson 2004		PA/PGA	Anderson 2004
Tragelaphus_eurycerus	1.723	Anderson 2004	5.291	Anderson 2004		PG	Anderson 2004; Lukas 2012; Lukas 2013; Pantheria
Tragelaphus_strepsiceros	1.964	Anderson 2004	5.285	Anderson 2004		PA/PGA	Anderson 2004; Ginsberg 1990
Trichechus_manatus	2.789	Reynolds 2004	5.650	Reynolds 2004		PA/PGA	Reynolds 2004
Trichosurus_vulpecula	0.602	Anderson 2004	3.562	Anderson 2004		PA/PGA	Anderson 2004; Pantheria
Tursiops_aduncus	3.312	Dines 2015	5.362	Dines 2015		PA/PGA	Pantheria
Tursiops_truncatus	3.090	Dines 2015	5.393	Dines 2015		PA/PGA	Pantheria
Tylonycteris_pachypus	-1.155	Ramm 2007	0.613	Ramm 2007		PA/PGA	Hosken 2001;

							Pitnick 2006
Tylonycteris_robustula	-1.000	Ramm 2007	0.924	Ramm 2007		PA/PGA	Hosken 2001; Pitnick 2006
Uncia_uncia	1.098	Iossa 2008	4.699	Iossa 2008		PA/PGA	Iossa 2008
Uranomys_ruddi	-0.458	Breed 2000	1.602	Breed 2000			
Urocitellus_beldingi	0.544	Soulsbury 2010	2.568	Soulsbury 2010		PG	Soulsbury 2010; Waterman 2007
Urocyon_cinereoargenteus	0.713	Soulsbury 2010	3.568	Soulsbury 2010		M	Iossa 2008; Soulsbury 2010; Pantheria; Lukas 2013; Lukas 2012; Ferguson 2004
Uroderma_bilobatum	-1.009	Pitnick 2006	1.173	Pitnick 2006		PG	Hosken 2001; Lukas 2013
Uromys_anak	1.064	Breed 2000	2.944	Breed 2000			
Uromys_caudimaculatus	0.857	Hayward 2011	2.914	Hayward 2011			
Ursus_americanus	1.590	Soulsbury 2010	5.010	Soulsbury 2010		PA/PGA	Iossa 2008; Soulsbury 2010; Pantheria; Ferguson 2004

Ursus_arctos	2.186	Soulsbury 2010	5.494	Soulsbury 2010	PA/PGA	Iossa 2008; Soulsbury 2010; Pantheria; Ferguson 2004
Ursus_maritimus	2.119	Iossa 2008	5.630	Iossa 2008	PA/PGA	Iossa 2008; Ferguson 2004
Ursus_thibetanus	1.824	Iossa 2008	5.001	Iossa 2008	PA/PGA	Iossa 2008; Ferguson 2004
Vampyrodes_caraccioli	-0.479	Pitnick 2006	1.430	Pitnick 2006	PG	Hosken 2001; Lukas 2013
Vampyrum_spectrum	-0.693	Pitnick 2006	2.201	Pitnick 2006	M	Hosken 2001; Pitnick 2006; Pantheria; Lukas 2013; Lukas 2012
Varecia_variegata	0.420	Anderson 2004	3.540	Anderson 2004	PG	Anderson 2004; Harcourt 1995; Lukas 2012; Lukas 2013
Vombatus_ursinus	1.265	Birkhead 1998	4.603	Birkhead 1998		
Vulpes_lagopus	0.609	Soulsbury 2010	3.681	Soulsbury 2010	M	Iossa 2008; Soulsbury 2010; Pantheria; Lukas 2013; Lukas

							2012; Ferguson 2004
Vulpes_vulpes	0.954	Hayward 2011	3.705	Hayward 2011		PG	Iossa 2008; Soulsbury 2010; Kenagy 1986; Lukas 2013; Lukas 2012; Ferguson 2004
Vulpes_zerda	0.736	Iossa 2008	3.176	Iossa 2008		M	Iossa 2008; Pantheria; Ferguson 2004
Wallabia_bicolor	1.169	Birkhead 1998	4.498	Birkhead 1998		PA/PGA	Rose 1997
Zaglossus_bruijni	1.908	Birkhead 1998	3.839	Birkhead 1998			
Ziphius_cavirostris	3.903	Macleod 2010	6.477	Macleod 2010			
Zyzomys_argurus	-0.363	Ramm 2007	1.653	Ramm 2007			
Zyzomys_woodwardi	0.238	Ramm 2007	2.009	Ramm 2007			
				Reptiles			
Acrochordus_granulatus	0.045	Olsson 1998	2.000	Macleod 2009			
Anolis_opalinus	-1.597	Olsson 1998	0.342	Macleod 2009			
Aspidoscelis_sexlineata	-1.018	Olsson 1998	0.903	Macleod 2009			

Aspidoscelis_tigris	-0.758	Olsson 1998	1.255	White 2006		
Calotes_versicolor	-0.677	Olsson 1998	1.164	Yu 2014		
Cerberus_rynchops	0.152	Olsson 1998	1.875	Macleod 2009		
Cnemidophorus_ocellifer	-0.194	Olsson 1998	1.877	Macleod 2009		
Eulamprus_quoyii	-1.638	Hayward 2011	1.362	Hayward 2011	PA/PGA	Noble 2013
Hemidactylus_flaviviridis	-1.514	Olsson 1998	0.477	Macleod 2009		
Lacerta_agilis	-0.724	Olsson 1998	0.924	White 2006	PA/PGA	Gullberg 1997
Laticauda_colubrina	-0.222	Olsson 1998	2.398	Macleod 2009	PA/PGA	Shetty 2002
Micrurus_fulvius	-0.263	Olsson 1998	1.477	Macleod 2009		
Naja_naja	1.377	Olsson 1998	2.826	Feldman 2016		
Notechis_scutatus	1.062	Olsson 1998	2.354	Macleod 2009		
Orthriophis_taeniurus	-0.004	Olsson 1998	1.882	Macleod 2009		
Phrynosoma_cornutum	-0.009	Olsson 1998	1.544	White 2006		
Podarcis_siculus	-1.405	Olsson 1998	0.879	Macleod 2009		
Pseudonaja_textilis	1.110	Olsson 1998	2.647	Macleod 2009		
Sceloporus_graciosus	-0.628	Olsson 1998	0.699	White 2006	M/PG	Tinkle 1973
Sceloporus_grammicus	-0.526	Olsson 1998	0.784	Macleod 2009	M/PG	Degnan 2004

Sceloporus_mucronatus	-0.681	Olsson 1998	1.240	Feldman 2016		
Sceloporus_occidentalis	-0.416	Olsson 1998	1.005	White 2006	M/PG	Schall 1987
Sceloporus_scalaris	-1.475	Hayward 2011	0.851	Hayward 2011		
Sceloporus_torquatus	-0.342	Olsson 1998	1.488	Macleod 2009		
Sceloporus_undulatus	-1.051	Olsson 1998	0.580	White 2006	PA/PGA	Ferner 1974
Tiliqua_rugosa	0.121	Olsson 1998	2.706	White 2006	M/PG	Olsson 1998
Tropidurus_torquatus	-0.686	Olsson 1998	1.680	Macleod 2009		
Varanus_indicus	0.429	Olsson 1998	3.087	Meiri 2010		
Varanus_olivaceus	0.786	Olsson 1998	3.640	Bennett 2000		
Vipera_aspis	0.052	Olsson 1998	1.837	Yu 2014	PA/PGA	Olsson 1998
Xantusia_riversiana	-0.734	Olsson 1998	1.279	White 2006		
Zootoca_vivipara	-1.408	Olsson 1998	0.505	Yu 2014	PA/PGA	Richard 2012

Table S2: Shifts in the rate of testes size evolution identified across the vertebrate tree of life in all groups, including rate increases found in individual species. Each entry in the table represents a species or group of species that is evolving at a different rate compared to the clade from which they descended (Ancestral Clade). It is important to note that not all species in the reported clade may belong to the shift, only branches leading to the number of species reported as N. The median optimized rate (σ^2_v) for both the branch leading to the heritable rate shift and the ancestral lineage from which it descends is recorded. Although there is variation in the median rates attributed to a single ancestral clade (e.g. Neognathae), these do not differ in terms of their distribution (see Methods, Results, Figure 3).

Vertebrate Clade	**Description**	**N**	**Log₁₀ σ^2_v**	**Ancestral Clade**	***Ancestral* Log₁₀ σ^2_v**
Fish					
	Order: Perciformes (all members)	26	0.003	Background (Vertebrates)	0.001
	Family: Cyprinidae (most members)	22	0.002	Background (Vertebrates)	0.001
	Pipefish, seahorses, and sea dragons (several genera)	12	0.002	Background (Vertebrates)	0.001
	True minnows (Genera: *Nocomis*, *Campostoma*)	5	0.008	Cyprinidae	0.002
Frogs					
	Superfamily: Hyloidea + Family: Myobatrachidae	126	0.005	Background (Vertebrates)	0.001
	Families: Dicroglossidae and Rhacophoridae	19	0.004	Background (Vertebrates)	0.001
	Genera: *Rana* and *Odorrana* (all members)	11	0.007	Background (Vertebrates)	0.001
	Genus: *Cyclorana* (three members)	3	0.112	Bufonoidea	0.040
	White-Lipped frogs (Genus: *Leptodactylus*)	3	0.030	Bufonoidea	0.005
	Family: Megophryidae (all members)	3	0.004	Background (Vertebrates)	0.001

Birds					
	Neognathae (birds excl. tinamous and ratites)	979	0.005	Neognathae	0.001
	Wading birds (Order: Charardriiformes)	18	0.016	Neognathae	0.005
	Kingfishers and bee-eaters (Order: Coraciiformes)	8	0.022	Neognathae	0.005
	Crows and relatives (Genus: *Corvus*)	7	0.046	Neognathae	0.005
	Gerygones and peep-warblers (Genus: *Gerygone*)	7	0.044	Neognathae	0.005
	Falcons (genus: *Falco*)	5	0.038	Neognathae	0.005
	Rufous-sided towhee complex (genus: *Pipilo*)	4	0.045	Neognathae	0.005
	Two species of orpopendola (Genus: *Psarocolius*)	2	0.100	Neognathae	0.017
	Two species of oriole (genus: *Oriolus*)	2	0.071	Neognathae	0.005
	Honeyeaters (Genus: *Conopophila*)	2	0.020	Neognathae	0.005
	Two species of friarbird (Genus: *Philemon*)	2	0.054	Neognathae	0.005
	Two species of manakin (Genus *Pipra*)	2	0.071	Neognathae	0.005
	Stiff-tailed ducks (Genus: *Oxyura*)	2	0.089	Neognathae	0.010
	Common redpoll (*Carduelis flammea*)	1	0.069	Neognathae	0.005
	Clamorous reed-warbler (*Acrocephalus stentoreus*)	1	0.090	Neognathae	0.005
	Shining flycatcher (*Myiagra alecto*)	1	0.070	Neognathae	0.005

	Puerto Rican Vireo (*Vireo latimeri*)	1	0.075	Neognathae	0.005
	Yellow wattlebird (*Anthochaera paradoxa*)	1	0.117	Neognathae	0.022
	Yellow honeyeater (*Lichenostomus flavus*)	1	0.062	Neognathae	0.005
	California gull (*Larus californicus*)	1	0.082	Neognathae	0.007
	Lesser scaup (*Aythya affinis*)	1	0.719	Neognathae	0.181
Mammals					
	All mammals excl. monotremes (Theria)	618	0.003	Background (Vertebrates)	0.001
	Whales and dolphins (Order: Cetacea)	58	0.020	Theria	0.004
	The mouse genus *Pseudomys* (all members)	10	0.019	Theria	0.005
	Rousettines + African megabats (Family: Pteropodidae)	7	0.024	Theria	0.004
	Mouse-eared bats (Genus: *Myotis*)	4	0.023	Theria	0.004
	Hopping mice (Genus: *Notomys*)*	4	0.061	Theria	0.004
	Sheep (Genus: *Ovis*)	3	0.050	Theria	0.005
	Asses and zebras (Genus: *Equus*)	3	0.058	Theria	0.013
	The mouse genus *Mus* (three members)	3	0.015	Theria	0.004
	Fawn hopping mouse (*Notomys cervinus*)**	1	0.005	Notomys	0.061
	California mouse (*Peromyscus californicus*)	1	0.098	Theria	0.010

	Yellow baboon (*Papio cynocephalus*)	1	0.055	Theria	0.018
Reptiles					
	Spiny lizards (Genus: *Sceloporus*)	7	0.001	Background (Vertebrates)	0.001
	Elapid snakes (Family: Elapidae)	5	0.004	Background (Vertebrates)	0.001

*This is the only rate shift identified that represents a "mean shift"; i.e. the branch leading to this group of taxa has an elevated rate, but the branches within the clade return to the rate of evolution observed within the ancestral clade.
** All rate shifts with the exception of this branch, leading to *Notomys cervinus* are rate increases. The branch leading to this taxa is evolving at a slower rate compared to its ancestor (in this case, both the mean shift leading to all *Notomys* species, and the rate acting across all Therian mammals).